



OIL PALM NEWS

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69









# OIL PALM NEWS

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H.C.

## EDITORIAL

As this issue goes to press the high prices of oils and fats on the world market is shared by unusually high palm oil prices (£110 per long ton for Malayan 5% ffa cif UK/Continent is quoted for May/June shipments in Public Ledger 3rd April 1970) - a stimulus to the would-be producer. Although large production increases are expected during the 1970s - especially in Malaysia (as noted in the report of the Editor's visit to the Far East included in this issue) palm oil in 1968 constituted less than 3% of total world supplies of oils and fats. Expansion in palm oil supplies will not, therefore be likely to have much effect on the overall world supply of oils and fats. However, in view of the uncertainty regarding the long term demand and supply conditions for oils and fats, it is essential that the palm oil industry should be as competitive as possible and that attention be paid to quality aspects and economic production.

With regard to quality, there is already a considerable amount of activity in the development of standard methods for testing palm oil both at a national and international level and some of this work is reviewed in the present issue.

French translations of certain articles from Oil Palm News Nos. 6, 7 and 8 appeared in Oléagineux, 1969, 24 (2) 69-72; (10) 563-568 and 1970, 25, (2) 97-98 respectively.

The final date for the receipt of articles and comments for the 10th issue, due to appear in November 1970, is the 7th of September.



## CONTENTS

	Page
Editorial	
S. C. Nwanze	1
Standards for the Palm Oil Trade	2
Visits to Sabah, Singapore and West Malaysia	4
Simple Bleachability Test	6
The Quality and Marketing of Oil Palm Products	7
Oil Palm Market Survey	10
Sabah Palm Oil	14
Book Review	15
Recent Publications	15
Training and Information	29



MR. S. C. NWANZE

It is with great regret that we note that the International Committee of the Red Cross has reported news of the death of Mr. S. C. Nwanze, sometime in May 1968 at the Catholic Mission Hospital, Ihiala (Fourth Annual Report of the Nigerian Institute for Oil Palm Research, 1967-68, page 10).

Mr. Nwanze became Acting Director of the Nigerian Institute for Oil Palm Research at the retirement of Mr. C. W. S. Hartley in 1963 and full Director in 1965. The Tropical Products Institute's relationship with Mr. Nwanze began in 1957 when he spent a short training period in our laboratories prior to taking up his first appointment at NIFOR as Research Engineer in the same year. The contact has been sustained and many readers of Oil Palm News will remember his presence and stimulating participation at the Oil Palm Conference held in London in 1965 where proposals for the establishment of the Bureau were first made. He was a corresponding member of the Bureau's consultant panel.

As Research Engineer, he filled a gap at NIFOR by initiating intensive research into processing techniques, particularly in the context of the peasant processor. As Director, he continued to take an active interest in this side of the work.

His untimely death is a great loss to the oil palm industry, particularly in Nigeria, and we extend our belated deep sympathy to his wife and family.

## STANDARDS FOR THE PALM OIL TRADE - SOME CURRENT DEVELOPMENTS

In view of the present and anticipated increase in world palm oil supplies, increasing interest has been shown recently in the development of suitable test procedures for crude palm oil which it is hoped will make possible more consistent quality control and lead to the setting up of internationally recognised standards more in line with user requirements than are available at present. This note is an attempt to briefly review some of the relevant work being carried out.

Measurements of f.f.a. (free fatty acid), moisture and volatile matter content, and dirt content have been standard practice for most of the oil entering the trade for edible purposes. It is well-known that the introduction in Nigeria in 1950 of Special Grade Palm Oil with an f.f.a. limit specification of  $4\frac{1}{2}\%$  at the ports, carrying an attractive premium, has been directly responsible for a rapid increase in the proportion of edible, as opposed to technical, oil being exported over the following decade.

Attention on the part of users has more recently been directed to tests for bleachability which will give a realistic indication of what will happen in the refining plant. More than ten years ago, bleaching tests for the crude oil were developed by the Institute in collaboration with the Fullers' Earth Union and various U.K. refiners with particular reference to Nigerian palm oil. These tests were based on the principal bleaching methods used industrially, i.e. physical adsorption of the carotenoid pigments on a bleaching earth and chemical breakdown of the carotenoids by heat. In the final form of the Earth Bleaching Test the oil is stirred with 5% by weight of activated Fullers' earth, Fulmont 700C for one hour at  $105^{\circ}\text{C}$  and the colour of the filtered oil measured on a Lovibond Tintometer. For the Heat Bleaching Test, the oil is heated in an inert atmosphere at  $230^{\circ}\text{C}$  for half an hour. A Combined Heat and Earth Bleaching test was also developed in which, after heating the oil in an inert atmosphere at  $230^{\circ}\text{C}$  for half an hour, 1% by weight of Fullers' earth Fulmont 700C is added, followed by a further 15 minutes heating at  $230^{\circ}\text{C}$  with swirling of the flask. The cooled oil is then filtered before the colour is assessed.

All three of these laboratory tests have proved useful in the examination of factors responsible for the deterioration of bleachability in the different stages of palm oil processing, and the earth bleaching test has proved particularly useful in producing countries. However, unlike the test for f.f.a., none of these tests are field tests which can be readily performed away from a laboratory, and such a test would be particularly valuable under peasant production conditions such as occur in Nigeria. Oil Palm News, No. 1., page 6 referred to experiments being carried out by T.P.I. on a field test. These were based on glass columns of standard internal diameter containing measured amounts of activated Fullers' earth through which was forced the sample of palm oil under test dissolved in chloroform. However, although preliminary work indicated that the method might be useful, snags were encountered in attempts to use it in Nigeria, owing to difficulties in obtaining reasonable flow rates. The experiments by NIFOR reported in their Quarterly Progress Report, No. 67 and noted on page 24 of Oil Palm News, No. 8, seem to be a modification of this test, and further work reported elsewhere in this issue indicates that the method is a promising one for field use.

In all the above tests, the bleached colours are assessed in terms of the Lovibond red and yellow units, or, particularly in the case of the field test, comparison with standard colour slides can be used to place the oils into bleachability grades.

Although good quality oils which show good bleachability by the Earth Bleaching Test may also show good heat bleachability, this is by no means always the case, since the two methods are entirely different in principle. On the whole the Earth Bleaching Test is more sensitive, particularly when oils have been oxidised, since such oils usually show greater bleachability deterioration by earth than by heat bleaching. However, very highly oxidised oils may show anomalous results in the Earth Bleaching Test.

While the producer, who may be concerned with checking many samples per day, may require a relatively rapid and simple procedure for bleachability, the user will probably be checking fewer samples, and will need to have some assurance that the results of the laboratory tests will compare with the behaviour of the same sample on the plant scale in his particular refining process. This is not easy, since the methods of refiners vary.

In the United Kingdom, the Technical Sub-Committee of the Edible Oil Refiners and Hardeners Association have been carrying out collaborative work on procedures involving a refining stage. They have chosen for further collaborative work, a test (called the E. O. R. H. A. Test) in which the sample is first neutralised by sodium hydroxide and then clarified by a 10 minute treatment with 1% by weight of Fullers' Standard Fulmont bleaching earth at 90°C. The filtered soap-free oil is subsequently heated under vacuum at 250°C for 15 minutes, allowing not more than 5 minutes to attain the above temperature, and not more than 10 minutes to cool to about 70°C before breaking the vacuum. This test seems to be suitable for use in the entire range of edible palm oil.

A test has been developed in Belgium for S. P. B. oils from the Congo with a maximum f.f.a. of 2½%. This involves heat-bleaching of the crude oil for one hour at 240°C in an inert gas, cooling to 60°C for colour assessment, followed by stirring with 1% by weight of Tonsil Standard FF bleaching earth at 110°C for 20 minutes under an inert atmosphere. In Germany, a heat-bleaching test at 300°C in an inert atmosphere for 45 minutes has been found useful for oils of up to about 5% f.f.a.

The Oils and Fats Section of the International Union of Pure and Applied Chemistry publishes Standard Methods of Analysis in French and English in loose-leaf form and at its meeting in Cortina in 1969, a small Sub-Committee met with representation from user countries including the United Kingdom, Belgium, Germany, Ireland, Netherlands and Sweden, to consider in particular palm oil bleachability standard methods. Those concerned are examining various specimens of oils by different bleaching tests, including the E. O. R. H. A. Test, and that proposed by Belgium; and their work is still in progress.

The Malaysian Oil Palm Growers' Council, which has been formed to serve the interests of all palm growers in Malaysia, has requested the Rubber Growers' Association in London to assist in the establishment of a Standard Malaysian Palm Oil to be marketed to comply with certain pre-determined specifications. To this end, the Association recently set up a small technical committee, including not only technical people from certain of their member companies, but also those representing certain users in the United Kingdom, and independent advisors in the palm oil field. With regard to bleachability, the E. O. R. H. A. Test, as well as some of the already mentioned alternative methods, has been under consideration. Possible tests for keepability are also being considered, although no particular test has been selected so far. Procedures for the determination of acidity, moisture and volatile matter, insoluble impurities, and oxidation, based upon

already published procedures for fats and oils generally, have been proposed, and the tests for some other characteristics of oils are still under discussion. The determination of the state of oxidation is difficult since oxidation of fatty oils is a complex process and no single test will give the complete picture. The Peroxide Value will give a measure of hydroperoxides formed but hydroperoxides are unstable and break down into other products such as  $\alpha, \beta$ -unsaturated aldehydes. The latter can be assessed by measurement of Benzidine Value although the carcinogenic nature of benzidine discourages its use in a routine test. Conjugated Diene Value, obtained from U. V. absorption measurements at 230nm, has also been found useful since peroxidation of the linoleic acid in palm oil results in the formation of conjugated diene hydroperoxides and other conjugated diene oxidation products. When suitable test procedures have been generally agreed it will be possible to consider particular limits which should be placed on the composition and characteristics of Standard Malaysian Palm Oil and of any other grades which may be of interest to buyers.

It is anticipated, and certainly to be hoped that the co-operative efforts outlined above to develop standard test procedures for palm oil will, in due course, pay dividends by enabling producers in all oil palm growing areas to market a consistent quality product related to user requirements in an increasingly competitive market.

#### SOME IMPRESSIONS ON SABAH, SINGAPORE AND WEST MALAYSIA (by Dr. J. A. Cornelius, October-November 1969)

##### Sabah

The oil palm industry in Sabah is young but rapidly developing, although having to cope with labour shortage problems peculiar to the country. In 1959 oil palms were first planted by the Commonwealth Development Corporation on their Mostyn Estate, and in 1961 the first palms were planted by Unilever Ltd. on their Estate at Tungud. By the end of 1969 the total estimated planted area amounted to 86,170 acres, the Tungud Estate being the largest single estate with 15,000 acres. Palm oil exports totalled 3,284 tons in 1966, 9,620 in 1967, 18,990 in 1968 and 13,000 tons in the first half of 1969. Yields in some parts of Sabah are believed to be reaching 3 tons of oil per acre and some believe that when new strains reach full bearing, 4 tons of oil per acre will be possible. Most of the oil has been going to the United Kingdom, but increasing amounts have been going to Japan, whose industry is apparently interested in oil of relatively high iodine value, although the reason for this is not clear. The palm kernels are exported to Singapore for local crushing. Estimated palm oil production for 1973 is 128,408 tons compared with 29,113 tons for 1969. By 1980 it is expected that the Sabah Land Development Board will be responsible for 50% of the total production.

At one estate there is an effluent disposal problem and an experimental "sludge farm" had been started some three months previously. The sludge appeared to be consolidating and supported a fungal growth. The liquid draining from it was considerably less unpleasant in odour and appearance than the original material. The state of the farm after a longer maturing time, and the possibilities of utilising the material for fertilizer, will doubtless be of interest to other estates with an effluent disposal problem.

Bulking facilities for palm oil are at present limited. The only bulking installations operating are one of 1,300 ton capacity for the BAL estates and one of 2,700 ton capacity at Kunak for the Mostyn and Giram Estates. The Sabah Land Development Board are in the course of erection of another at Karamunting, near Sandakan.

### Singapore

Singapore served chiefly as a base for visiting projects in Johore, but the opportunity was also taken to visit the Bulking installation of Guthrie Waugh (Singapore) Pte. Ltd., which handled in 1969, 105,000 tons from West Malaysian estates and 10,000 tons in 44-gallon drums from FLDA small-holders. The total annual throughput is expected to reach 280,000 tons by 1975.

### West Malaysia

In contrast to Sabah, the oil palm industry here has been established for some years, the first commercial plantings being in 1917 at Tennamaram and the Pamol Estate at Kluang being first planted in 1929. However, most readers will be aware that with many firms, originally concerned with rubber, branching out into the oil palm field, there has been a considerable increase in production, particularly during the last decade. With an anticipated total palm oil production for the whole of Malaysia approaching one million tons by 1974 and possibly even 2 million tons by the 1980's, the Palm Oil Symposium in Kuala Lumpur was timely. In view of the anticipated increased competition with other fatty oils, the opportunity afforded by the Symposium to bring before producers some of the factors affecting palm oil quality from the users' point of view was most valuable. The value of such a symposium would, however, be greatly enhanced by a greater representation of end-users.

At present most of the palm oil is produced by the private sector of the industry, and they have their own research and breeding programme, and have a Pool for marketing the oil. The Division of Agriculture and Co-operatives also has a breeding programme and is producing planting material at a rate of 850,000 seeds per annum, largely for the FLDA (Federal Land Development Authority) schemes. Since the FLDA now have over 167,000 acres planted with oil palms and plan to increase at a rate of some 20,000 acres per year over the next five years, this organisation will become by far the largest single producer. With the inauguration of MARDI (The Malaysian Agricultural Research and Development Institute) just prior to my visit, the future development of oil palm research, both at the production and end-user end, is currently under consideration and discussion. It would seem that development along similar lines to the existing set-up for rubber is the most feasible (Planter, 1969, 45, 176-185).

Estates visited included that of Pamol at Kluang, the Commonwealth Development Corporation at Kulai and the United Plantations Estates at Ulu Bernam and Jenderata. The mill at Ulu Bernam provided the opportunity to see three makes of presses operating side by side. All the foregoing are old established plantations.

Somewhat younger estates of Harrisons and Crosfield at Dusun Durian and Cary Island and of the FLDA at Sungei Dusun and Sungei Tengei were also seen.

#### SIMPLE BLEACHABILITY TEST (Nigerian Institute for Oil Palm Research)

A simple bleachability test was described in the NIFOR Quarterly Progress Report No. 67, page 6 and reported in Oil Palm News, No. 8, page 24. Tests have since been carried out on palm oil samples collected from different places in the Mid-West State. Thirty four samples of palm oil with widely varying characteristics were analysed for their residual colour by the new method developed here as well as by the standard oil bath method (heating with 5% w/v Fullers' earth at 105°C for 1 hour and then filtering). We are glad to inform you that the two series of values were found to be highly correlated ( $r = 0.811$ ,  $P < 0.1\%$  and regression coefficient  $b = 0.489$ ). This means the colour values obtained by the new simple method truly reflect the bleachability of the oil and on account of its simplicity can be very well recommended as a field method for testing bleachability of palm oil samples. Studies are continuing.

## THE QUALITY AND MARKETING OF OIL PALM PRODUCTS.

Summaries of selected papers read at a Symposium. Kuala Lumpur, Malaysia - November 1969.

(The Incorporated Society of Planters. P. O. Box 262, Kuala Lumpur)

### Field factors affecting quality of Palm Oil

(B. S. Gray and J. W. L. Bevan)

No matter how good processing and shipment standards are, the quality of palm oil cannot be improved beyond that of the oil in fruit arriving at the mill. Quality is inextricably related to harvesting standards. During the pre-processing stage the quality factor most influenced by agronomic techniques is free fatty acid content, and the origins of f.f.a. are discussed. Loose fruits are particularly high in f.f.a. levels and their numbers are related to the harvesting criteria employed. It is apparent that a compromise between quality and quantity must be reached, and different harvesting systems are discussed. Good field control prevents f.f.a. rise through the activities of lipolytic microorganisms. Speed of processing after harvesting, together with minimal damage, are important factors, with increased mechanisation possibly leading indirectly to quality improvements. Objective methods of checking harvesting standards are suggested. The organisation of a daily harvesting programme is described.

### The influence of milling and storage conditions on Palm Oil quality

(B. Jacobsberg, Tropical Products Sales, Brussels, Belgium)

As new methods of palm oil refining are developed and new ways of using the refined oil in manufactured products are found, quality requirements for crude palm oil steadily increase.

The main factors affecting the quality of the crude oil, and thus its keepability and behaviour on refining, were studied in detail at a pilot plant in the Congo Republic over a four-year period. A systematic investigation of the effects of the various processing steps during milling was made and this has been followed by more than 15 yr of laboratory investigations.

It has been found that palm oil can be produced with a very low f.f.a. content - even below 1% as palmitic acid. This requires due care, including limiting the amount of hydrolysis caused by fruit lipase and the avoidance of f.f.a. increase in the crude oil through autocatalysis or microbial spoilage.

If oxidation of the oil is avoided as far as possible, heat bleaching (during which the carotene pigments are destroyed) will give a very light-coloured bleached oil, even without the use of bleaching earth. Residual colours are due to a combination between the carotene and oxidised fatty acids at high temperatures; hence the need to limit oxidation. This may be done by avoiding lipoxidase activity in the fruit before sterilising, by preventing contamination of the oil by heavy metals, such as copper, which promote oxidation and by avoiding undue contact between the oil and air at high temperatures.

The different production stages of palm oil from harvesting and milling the fruit to transport and storage of the oil are examined in the light of the above facts.

Bleaching and keeping properties are closely linked as they are both reduced by oxidative deterioration.

It is very important that palm oil should remain stable over long periods since several months usually elapse between production of the oil and its use. To achieve this stability requires continuous care during production and carelessness at any single point in the process can irrevocably lower oil quality.

### Lipolytic Microorganisms in Stored Oil

(P. D. Turner, Harcross Advisory Services, Banting, Malaya)

During the pre-processing stage, lipolytic fungi and other microorganisms bring about oil degradation mainly through pathogenic attack and following invasion of fallen ripe fruit. The effect of fungal attack, especially by yeasts, Fusarium spp. and Geotrichum candidum, is not likely to be great unless field conditions are such as to allow their prolonged development. During palm oil manufacture yeasts, Aspergillus spp., Rhizopus nigricans, G. candidum, Sporobolomyces sp. and Neurospora sitophila were frequently isolated but were considered unlikely to be of any practical significance in well-run mills. Biodeterioration of kernels is much more of a problem, with potentially-serious microorganisms reaching the kernels during separation from the shell, and rapid drying is required to prevent f.f.a. level increases. No deterioration of stored oil due to microorganisms could be found; this is unlikely as oil is stored in a pure state. The Malaysian findings are compared with those elsewhere. In general, it would appear that although there exists a natural abundance of lipolytic fungi, absence of the conditions allowing them to develop renders them of little significance under normal conditions of oil production but of somewhat greater importance in kernel quality.

Palm Oil bulking and shipping and related changes in quality  
(L. F. Natta, Socfin Co. Ltd., Kuala Lumpur, Malaya)

Palm oil reaches port bulking installations with certain quality characteristics. Handling of the oil in and out of the installation must be organised in a manner allowing as little deterioration as possible.

In spite of all precautions, slight changes in quality are bound to occur, particularly as regards free fatty acid content and peroxide value. A survey was undertaken of the evolution of these factors for oil delivered by eleven producers into a 12,000 ton storage installation.

Time of storage was found to average 3 weeks to 1 month, during which f.f.a. levels increased by 0.20 to 0.25 percentage unit. F.f.a. continues to increase during the sea journey to consumers' countries but often in an unpredictable manner. Unification of analytical procedures and standardisation of temperature conditions of the oil during transit appear to be highly desirable.

P.V. of oil received at the installation was found to range between 1.0 and 2.7 mmole. A certain amount of deterioration takes place during storage but determinations carried out on a large number of samples indicated that the P.V. of oil shipped out from the installation was remarkably constant at 3 mmole.

The implications of the recorded increase in f.f.a. values and P.V. and on handling procedure in the bulking installation are discussed.

Future developments in the shipping of Malaysian Palm Oil  
(J. D. Menneer, Harrisons and Crosfield (Malaysia))

At present, palm oil is transported in different types of cargo ship, which leads to problems in quality control. A number of desirable features for minimising oil degradation during shipment for future oil tankers are discussed, especially temperature control. Carriers' and shippers' responsibilities are outlined, with suggestions for improvement, and the need to guarantee out-turn specifications mentioned. The great expansion of palm oil production in West Malaysia is considered in light of the considerable strain which will be placed on road transport and port installation facilities, and a possible solution presented.

## OIL PALM MARKET SURVEY - A REPORT BY THE COMMONWEALTH SECRETARIAT

In retrospect the main features of the world oil palm situation in 1969 were the continued expansion in palm oil production, principally in Malaysia, the failure of palm kernel output to rise above the 1968 level, and the sharp rise in prices, both of palm oil and palm kernels and oil, associated with the edible oil boom of last autumn, which persisted into the first quarter of this year.

Preliminary statistics indicate that world commercial production of palm oil once more rose substantially in 1969, the increase of about 10 per cent being proportionately about the same as in 1968. Expansion was again mainly in Malaysia, where the overall advance of some 65,000 tons represented an increase of nearly a quarter. Furthermore, a notable recovery in Nigerian production is suggested by the shipment figures of the Nigerian Produce Marketing Company, although not shown by the incomplete official purchase figures. The decline registered in exports from the Congo (Kin.) points to a moderate fall in this country's palm oil production in 1969; earlier predictions had been for a continuation of the upward trend in Congolese output. Among the other major producers there appears to have been little significant change in the volume of palm oil production in 1969. World exports of palm oil, which totalled some 625,000 tons in 1968, were probably about a tenth greater in 1969, thus showing a rise roughly commensurate with the growth in world production.

Initial expectations of a further modest advance in world production of palm kernels in 1969 have not been confirmed by the most recent production estimates. In Nigeria, for example, where kernel purchases in the first half of the year were somewhat above the corresponding 1968 level, figures for the whole year show virtually unchanged output as compared with 1968. An increase in supplies of some 30,000 tons, derived mainly from a further rise in Malaysian output but also from record production in Dahomey and Togo, was largely offset by declines in the Congo, Cameroun and Sierra Leone. Of these, the estimated drop in Congolese production indicated by the export statistics was clearly the dominant factor in preventing any significant rise in world kernel output during 1969.

Commercial production of palm kernel and palm oils  
(thousand tons)

	1965	1966	1967	1968	1969
	oil equivalent <u>a</u> (kernels)	oil equivalent <u>a</u> (kernels)	oil equivalent <u>a</u> (kernels)	oil equivalent <u>a</u> (kernels)	oil equivalent <u>a</u> (kernels)
<u>Palm kernels</u>					
Nigeria	211 (449)	195 (415)	102 (218)	89 (190)	89 (189)
Sierra Leone	23 (49)	21 (45)	17 (36)	25 (54)	24 (52)
West Malaysia	16 (34)	20 (43)	23 (48)	28 (59)	35 (75)
Angola	8 (17)	8 (17)	9 (20)	7 (15)	7 (15)
Cameroun	13 (27)	10 (21)	10 (21)	8 (18)	6 (14)
Congo (Kin.) <u>b</u>	45 (95)	47 (100)	49 (105)	61 (130)	52 (110)
Dahomey	23 (49)	22 (46)	19 (41)	26 (55)	29 (62)
Indonesia	15 (32)	16 (35)	16 (34)	18 (38)	18 (38)
Ivory Coast	7 (15)	4 (9)	5 (10)	4 (9)	4 (9)
Mexico	12 (25)	12 (26)	12 (26)	12 (26)	12 (26)
Togo	6 (14)	8 (16)	6 (12)	7 (15)	9 (20)
Other	25 (53)	24 (51)	28 (59)	30 (62)	32 (65)
Total	404 (859)	387 (824)	296 (630)	315 (671)	317 (675)
<u>Palm oil</u>					
Nigeria	164	130	32	4	25
East Malaysia (Sabah)	2	4	10	19	25
West Malaysia	146	183	213	261	320
Angola	15	15	15	13	12
Cameroun	15	15	20	23	20
Congo (Kin.) <u>b</u>	160	165	200	240	220
Dahomey	14	11	11	13	15
Indonesia	160	149	171	177	180
Ivory Coast <u>b</u>	7	8	9	10	12
Others	25	24	32	38	46
Total	708	704	713	798	875

a Converted at 47 per cent oil content. b Estimates.

World exports of kernels and oil from primary producers, which amounted to 295,000 tons, oil equivalent, in 1968, appear to have been practically unchanged last year, the proportions shipped as seed and oil remaining at about three-fifths and two-fifths respectively. The decline in Congolese oil shipments and in sales of kernels by Sierra Leone was accompanied by sizable increases in Nigerian oil and kernel exports. Indeed the volume of Nigerian exports of seed and oil combined appears to have exceeded officially reported Nigerian kernel purchase figures in both 1968 and 1969, especially in the latter year. Possibly the official purchase figures have under-reported the true volume of kernel production or crushings and exports have been sustained out of stocks, or a combination of these two factors may have been at work.

The outlook for 1970 is for increased supplies of both palm oil and kernels. As regards palm oil another large advance in output is looked for in West Malaysia, while the ending of hostilities in Nigeria is likely to result in further additional supplies being available from this country. The increased production in Malaysia and Nigeria, together with the greater output which will probably be marketed by smaller producers, is likely to bring world commercial production of palm oil this year to a new peak of over a million tons. The degree of recovery in world palm kernel output in 1970 will be principally determined by the size of the increase expected in Eastern Nigeria, although heavier supplies are also predicted for Malaysia and possibly the Congo. However, the upward limit for additional production this year will probably not exceed 100,000 tons, bringing the world total at most to some 775,000 tons, or about 365,000 tons, oil equivalent.

Mid-month prices of palm oil, palm kernels and palm kernel oil

(£ s. per ton, nearest forward shipment, c.i.f. U.K. ports, excluding duties)

	1968 Average	1969 Average	1969				1970		
			June	Oct.	Nov.	Dec.	Jan.	Feb.	March
Palm oil, Malayan 5%	71 10	76 15 <sup>a</sup>	70 0	87 0 nom.	..	..	108 0	108 10	110 0
Palm kernels, Nigerian, resellers	75 10	64 15	60 5	63 8	70 18	75 0	71 10	73 10	74 5
Palm kernel oil, West African	155 5	129 10	118 0	130 0	139 0	150 0	..	147 0	150 0 nom.

<sup>a</sup> Average of 10 months only.      nom. = nominal.

The boom in edible oil prices which began last autumn and persisted more or less without interruption into March, had dramatic effects on palm oil values as well as important repercussions on quotations for palm kernels and oil. The boom, which had its origin in a number of factors, including shortages of sunflower and marine oils and a run-down in consumer stocks last summer in anticipation of lower prices in the autumn, caused palm oil quotations to advance by a quarter between October and December. Nevertheless, despite the price rise, palm oil was in keen demand by consumers since it was at substantial discounts to soya and sunflower oils, and therefore continued to be sold well forward. Because of its price advantage appreciably larger palm oil imports were made in 1969 by the United Kingdom, Italy, the Netherlands, the United States and Japan. Values remained extremely firm in the early months of this year, and sales made in March for May/June shipment took place at no less than £110 per ton.

The shortage of lauric materials maintained values of palm kernels and oil at very firm levels in the middle of last year. Furthermore, in the autumn, when world lauric oil supplies had further diminished and prices had again advanced, the edible oil boom also re-acted on lauric values, leading to increased demand for laurics for edible use. Peak values for palm kernels and oil in 1969 were attained in December; subsequently quotations eased somewhat, although they recovered in March of this year with the continued buoyancy of the edible oil market.

The outlook for future prices at the time of writing is uncertain. Although some down-turn in edible oil values is probable in the next few months, the scope for downward movement could be limited by shortages of groundnut, sunflower and marine oils, and price reductions could therefore be comparatively small. Nevertheless, lower values for edible oils and more especially for marine oils would tend to depress palm oil prices, although possibly not very much in the first instance. An important factor will be the extent to which world palm oil supplies actually increase in 1970, especially those from Malaysia and Nigeria. As for palm kernels and oil, the likelihood is that lauric supplies will remain relatively restricted in the first half of 1970, so that values may be expected to remain reasonably firm. However, as with palm oil, any significant easing in prices in the edible oil market would probably result in some lowering in the general level of lauric quotations as well.

#### SABAH PALM OIL - A NOTE FROM HARRISONS AND CROSFIELD LIMITED

The tonnage of Palm Oil produced in Sabah during 1969 was 24,068 tons, and production this year is estimated at around 33,000 tons.

During 1969 the main destination was U.K., but during the second half of the year increasing quantities were shipped to Japan. In addition, shipments were made during the year to Manila, Lisbon, and Northern Europe. Total shipments from Sabah advanced from 18,990 tons in 1968 to 25,621 tons.

It seems likely that the bulk of the Palm Oil produced during 1970 will continue to be shipped to the U.K. or to Japan. It is also expected that, by the second half of the year, the Sandakan Bulk Installation will have been completed, and will be ready to receive Oil for bulk shipment.

## BOOK REVIEW

### PROGRESS IN OIL PALM

(Proceedings of the Second Malaysian Oil Palm Conference, Kuala Lumpur. November 1968. Edited by P. D. Turner. 321 pp. Incorporated Society of Planters, Kuala Lumpur 1969. Price £5 12s. 6d.)

This book consists of the collection of the papers presented at 1968, Malaysian Oil Palm Conference. The subjects covered range from plant breeding to processing the fruit, with a section on catch-cropping and inter-cropping. Altogether there are seven sections under the headings of Breeding and Nurseries; Assisted Pollination and Fertilisers; Palm Oil and Processing; Pests and Diseases; Pesticides and Upkeep; Catch-cropping and Inter-cropping; Harvesting and Transport. Items of interest which will be of use to all interested in the crop, can be found under each heading, although the contribution to Processing is disappointingly small.

Altogether the papers should be of value to all those connected with palm oil industry but particularly those interested in the establishment, maintenance and cultivation of estates and are a useful adjunct to "Oil Palm Developments in Malaysia"; papers presented at the First Malaysian Oil Palm Conference in 1967.

## RECENT PUBLICATIONS

### Brazil

#### OIL PALM BECOMES A CULTIVATED CROP

(Anon. (Coopercotia, 1968, 25 (226) 24-5))

Stimulated by the demand for palm oil for the steel industry, a new palm oil factory was built in 1964 at Taperca in the State of Bahia. Spontaneous oil palm planting covers approximately 10,000 hectares in the coastal zone, 1 - 2.5 km wide. The fruits, many of the dura type, contain 57% pericarp, 34% shell and 9% kernel. Yields are low. The company has started to promote improvement of these stands and yields in these improved plantings have increased by 100%. Good tenera planting material is sold for new plantations. In 1967, 55,000 seedlings were distributed and in 1968 this number may increase to 150,000. A new factory situated in the Iguapa valley with a capacity of 45,000 tons of fresh fruit bunches per year is under construction.

### Cameroons

#### MORE PALM OIL FOR CAMEROON

(Anon., Ceres, May - June 1969, 2 (3) 7)

A project for stepping up palm oil production in Cameroon, geared to meet growing material demand for edible fats, will be jointly financed by the World Bank, two French contributors, Fonds d'aide et de Co-operation (FAC) and the Caisse Centrale de Co-operation Economique (BCCE) and the Cameroon Government. This undertaking aims at stemming the decline in national palm oil output and it will also have a significant impact on agricultural development of Eastern Cameroon's sparsely populated wooded areas, unsuitable for cultivating other kinds of crops.

The plan calls for: the planting of oil palms on two estates totalling 22,400 acres over a period of eight years; an oil mill on each of the two estates; and the construction of roads, buildings and other essential structures. Once fully under way in 1981, the oil mills will turn out 26,000 tons of palm oil and 6,000 tons of kernels annually. Two thousand permanent new jobs will be created. This is the second Cameroon agricultural project to be aided by the World Bank group. (See also Oil Palm News, May, 1969, No. 7, page 18 - Editor.)

### Colombia

#### NEW OBSERVATIONS ON PROGRESSIVE WILT AND SUDDEN WILT OF AFRICAN PALM IN THE META ZONE

(A. Sanchez Potes, Agricultura Trop., 1968, 24 (8) 451-460)

Symptoms are described of the three main disorders of oil palm in Colombia; 'small leaf' (due to Boron deficiency), progressive wilt (deficiency of certain nutrients, principally potassium, phosphorous and magnesium) and sudden wilt affecting most of the root system beginning with the rootlets. Certain fungi, e.g. Fusarium, Rhizoctonia and Pythium were associated with the last disorder but their pathogenicity has not yet been established.

### Congo

#### AGRICULTURAL PRODUCTION IN THE CONGO - PALM PRODUCTS

(F. Degiordio, U. S. D. A. Economic Research Service, September, 1969)

Palm products - palm oil, palm kernel oil and palm kernel cake; are the Congo's most important agricultural export commodities, production has been gradually recovering from 1965 lows but remains about 30 per cent below 1959 level. For production to reach preindependence levels, new plantings will be necessary. Low world prices for palm products in recent years have reduced incentives for plantations to increase production and for farmers to harvest wild fruit. About 80 per cent of production was from plantations, where the crop is collected and marketed by Congopalm, a co-operative for the plantations. An increasing proportion of palm products has been diverted to domestic use in recent years for the manufacture of soap, margarine and cooking oils.

### Ivory Coast

#### IVORY COAST EXPANDS COCONUT AND PALM OIL

(Anon., Ceres, 1969, 2 (4) 11)

The World Bank will grant three loans totalling \$17.1 million to the Ivory Coast. The loan will permit the planting of 39,500 acres of oil palm and 16,000 acres of coconut palm and the construction and equipment of an oil mill.

Oil palm cultivation will be undertaken on large plantations as well as by individual planters enabling 4,000 of the latter to make the transition from subsistence to market agriculture. The project is being executed in close co-ordination with the entire Government programme for development of palm oil production on an area of 148,000 acres. Investments for this part of the programme come to about \$54 million, the largest contribution by far is from the European Development Fund. (EFD). The European Investment Bank and France's Caisse Centrale de Co-operation Economique will assist in the financing of five other mills through loan to Palmindustrie for a total of \$9.1 million each.

## A TYPICAL CASE OF POTASSIUM DEFICIENCY IN THE OIL PALM IN THE IVORY COAST

(A. Bachy, Oléagineux, 24 (10) 533-540) [English and Spanish summaries, 6 lines]

An experiment set up at La Mé (Ivory Coast) in 1954 with 8 year old palms revealed a pronounced potassium deficiency; after 14 years of experimentation, no secondary deficiency has become apparent. This special situation enables the influence of potassium on the yield components to be studied, and the origins of the annual fluctuations in production to be examined. The regulating role of potassium is noted together with its incidence on the exchangeable K content of the soil and on the levels of other mineral elements in the leaves. As a follow up to this basic experiment, a new series of experiments has been set up at La Mé in order to determine the role of potassium in the early stages.

## THE EFFECTS OF IN-BREEDING IN OIL PALM

(J. P. Gascon, J. M. Noirey and J. Mennier, Oléagineux, 1969, 24 (11) 603-607) [English and French summaries, 11 lines]

This article describes the main results obtained by selfing the two origins, La Mé and Deli, and the crosses (La Mé x Deli) x Deli planted at La Mé in the Ivory Coast.

A comparison with the La Mé x Deli hybrids shows a reduction of yield in the early years amounting to 50 per cent for selfings and 25 per cent for  $\frac{3}{4}$  Deli. In the same way the quality of the bunch, in particular the quantity of oil in pulp is notably affected by in-breeding. Finally, numerous abnormal characters are brought out by selfing.

These results draw attention to the need for avoiding any in-breeding in crossing programmes intended to produce seed. Nonetheless, selfing remains very useful in the selection of a perennial, allogamous plant such as the palm.

## MECHANISATION OF BUNCH COLLECTION

(P. Coomans, Oléagineux, 1970, 25 (1) 1-10) [English and Spanish summaries, 6 lines]

The first trials undertaken at the request of Sodepalm on the La Mé station, Ivory Coast concerning the mechanisation of carrying bunches to the end of each line have aroused interest in dumper-type equipment. In view of possible rises in wages, the use of dumpers would rapidly prove competitive, by comparison with the manual method, on plantations producing a minimum of 14 tons/bunches/hectare/year with an average bunch weight of 10 kg. If this material is used the labour force employed in conveying bunches can be reduced by 50 per cent, each dumper being able to collect over 220 hectares. Other types of equipment are now being tried out.

## Liberia

### THE AGRICULTURAL SITUATION IN AFRICA - LIBERIA

(Anon, Midyear Review, 1969, U. S. D. A. Economic Research Services)

Liberia's first industrial plant for palm oil produced its first 25 tons in 1968. The plant is located on the Tidewater Oil Co. plantation in Grand Bassa County. By the end of 1969, Tidewater will complete planting of its projected 5,000 acres of oil palm. At the same time, in Grade Cape Mount County, the West Africa Investment and Finance Corporation has begun development of a 3,800 acre oil palm plantation. Technical assistance and seeds are supplied by I. R. H. O. Several thousand acres of land have been cleared, an oil palm nursery is in operation, and transplanting is under way.

## Malaysia

### ADB (ASIAN DEVELOPMENT BANK) TO ASSIST IN MARKETING STUDY OF MALAYSIA'S OIL PALM PROJECT

(Anon, ADB News Release No. 27/69, September 1969, Asian Development Bank, Ayala Avenue Makate, Rizal, Phillipines)

The ADB has approved a request from the Government for technical assistance in conducting a marketing study of oil palm products. The study, to be made by a consulting firm, will review the oil palm products marketing arrangements of the FLDA (Federal Land Development Authority). The study will specifically examine the suitability of present marketing arrangements of the FLDA in assessing future needs. This will involve projection of short and long term output and exports of palm oil and kernels for Malaysia as well as for FLDA.

The FLDA is planning its own bulk handling and storage facilities scheduled to be completed in 1971. This will enable the organisation to become a shipping party in its own right with representation on the Joint Selling Committee. At present the FLDA palm oil is exported through two shipping parties within the framework of the Malayan Palm Oil Pool.

The FLDA initiated its first palm oil scheme in 1961. Since then it has fostered twenty-two oil palm schemes, involving 93,880 acres - a quarter of the total acreage with the crop. The FLDA plans to expand its palm oil production so that by 1975 it will produce about 26 per cent of the country's estimated total of 1.3 million tons. Successful execution of the expansion plans will make the government agency the largest oil products exporter in Malaysia.

### POPULATION STUDIES ON THE MALAYSIAN WOOD RAT (Rattan tiomanicus) IN OIL PALMS

(B. J. Wood, The Planter, 1969, 45 (523) 510-526)

A programme of experiments is being conducted on the rat, R. tiomanicus in oil palm, and a preliminary account is given. A wax-bound bait (Kg-22) based on maize, with anti-coagulant poison, has proved highly effective. A practical means of assessment is suggested for estates, by census baiting (more than 20 of 50 taken means control needed). Fresh damage checks or trapping pests are alternatives. Routine baiting should be, so far as can be determined at present, at 6 month intervals.

STUDIES ON THE EFFECT OF GROUND VEGETATION ON INFESTATIONS OF  
Oryctes rhinoceros IN YOUNG OIL PALM REPLANTINGS IN MALAYSIA  
(B. J. Wood, Bull.ent.Res., 1969, 59, (1) 85-96)

Oryctes rhinoceros L. is a major pest of oil palms in Malaysia. Oil palm plantations may be the first planting after jungle clearing or may follow, coconut, rubber or previous oil palm stands. Usually there is ground vegetation, either natural or planted legumes. Many planters in Malaysia believe that O. rhinoceros is less important in replantings where ground cover is encouraged early and remains dense. A similar phenomenon has been noted in the S. Pacific where vegetation up to crown height appears to protect mature coconut palms from attack. This has been termed the 'vegetative barrier' effect. The paper describes experiments investigating the influence of ground vegetation on the incidence of O. rhinoceros in young oil palm replantings.

ASSISTED POLLINATION OF OIL PALMS

(B. S. Gray, Oléagineux, 1969, 24 (12) 661-669) [English and Spanish summaries, 12 lines]

In oil palm areas in Malaysia, there is a fluctuation in the density of atmospheric pollen during the year; at times, the density is so low that pollination by natural means does not give satisfactory fruit set. Assisted pollination has a very marked positive effect on the number of male inflorescences produced in the early years of bearing and promotes adequate yields.

Oil experiments and experiences discussed here, are concerned mainly with D x D and D x T material grown on coastal clay soils. Data on the effects of genetic, environmental and agronomic factors on pollen are still inadequate. Yet, much is already known on pollen viability and its wide monthly variability in density, the production and increase of the number of male inflorescences produced through castration treatment and heavy pruning respectively. Finally, all treatments which develop growth of the palm, tend to favour the production of female inflorescences.

To conclude, the author suggests adopting a few practices aimed at fixing the period during which assisted pollination should be carried out and reducing its cost.

THE COCKCHAFFER (Psilopholis vestita) A NEW PEST OF OIL PALM IN WEST MALAYSIA

(B. J. Wood and Ng Kwang Yew, The Planter, 1969, 45 (524) 577-586)

Two outbreaks of the cockchafer, Psilopholis vestita have been recorded on oil palm in Johore during the period 1967-68. In an attack on a four year old area of 60 acres, the worst affected palms suffered severe setbacks in yield and growth. The other was on 300 acres recently planted. Ground vegetation was killed off over large areas in both attacks. The cockchafer has a one year life cycle and grubs do most damage in August/September. Outbreaks are located near jungle, inside which the adults must feed before mating and egg laying.

Numerous biological control agents exist, cultural measures have some effect and the adults are attracted to lights. The planter faced with an attack, is advised to apply soil insecticides at palm bases and if the attack persists, rotovate interlines and apply soil insecticides overall. Adult control using light traps, or soil treatment prior to egg laying, may also be advantageous in subsequent years.

#### CATERPILLAR OUTBREAKS ON OIL PALMS IN EASTERN SABAH (B. J. Wood and D. P. Nesbit, The Planter, 1969, 45 (518) 285-289)

Since 1966 there have been severe and widespread outbreaks of leaf eating caterpillars in oil palm in Eastern Sabah, which have built up with an alarming rapidity and intensity. The main problems have been with the coconut case moth (Mahasena corbetti) and the two nettle caterpillars, (Darna trima and Thosea asigna), all three have recently been described in relation to oil palm (Wood 1968). Control measures are described.

#### SOILS OF SOUTH JAHORE AND MANURING OIL PALMS (Siew Kee, The Planter, 1969, 45 (519) 348-358)

Jahore is the premier oil palm growing state in Malaysia and a considerable amount of money is spent annually on fertilisers to ensure proper nutrition and high production. Naturally, growers are anxious to ascertain if the expenses are technically and economically justified. In order to make an assessment it is necessary to have a fair understanding of the background on which fertiliser recommendations for oil palm are made. There are four principal considerations for formulating a fertiliser programme on an annual basis:

- (1) Soil condition
- (2) Nutrient balance sheet for oil palm
- (3) Foliar analysis data
- (4) Fertiliser type and mode of application.

The author discusses these four considerations in detail.

#### THE USE OF HERBICIDES IN OIL PALM ESTATES (P. Ramachandran, J. C. Knecht and P. G. Martineau, Oléagineux, 1969, 24, (8-9) 467-472) [English and Spanish summaries, 11 lines]

Sequential applications of Gramoxine and MSMA/sodium chlorate mixture at 4-monthly intervals gives adequate control of palm circles in mature areas. Hand weeding is the only safe method for upkeep of circles at present in immature plantings. Simazine did not prove effective. Diuron should be screened for toxic effects before firm recommendations are made. Herbicides based on formulations of 2,4-D and 2,4,5-T, halogenated aliphatic acids and dipyrityl compounds are generally adequate for all types of noxious growth control in mature areas. Mikania and ferns of a Cyathea species can be controlled in mature plantings with formulations of 2,4-D amine at acceptable costs and without crop injury. In immature plantings, control of most of the noxious growths is achieved by wiping with herbicides mentioned above.

High level application of hormones in which the active ingredient is volatile is also dangerous, even to tall palms, and can result in loss of crop. Sodium arsenite is still very useful to clear areas to be planted or replanted but is now superseded in standard upkeep by more efficient weedicides at competitive costs.

## Nigeria

### NIGERIAN OIL PALM RECOVERY

(Anon, West Africa, June 1969, (2717) 747)

Figures for Nigeria's oil palm production in the first quarter of this year (excluding the South Eastern State) show that palm kernel purchases at 44,000 tons, were considerably higher than a year ago, says the Commonwealth Secretariat's Tropical Products Quarterly. Most of the expansion was due to heavier purchases in the Western and Northern States. Palm oil purchases, mainly in the Mid-West, were also somewhat higher.

## Papua - New Guinea

### PALM OIL SCHEME TO BE BIGGER

(Anon, Australian News, 1969, July 24th, page 2)

An area now being surveyed on New Britain will increase by one third the size of the first big palm oil scheme in the territory of Papua - New Guinea.

The extension is still being considered by Australia's Department of External Affairs, but surveyors have already begun mapping out the area into 390 individual blocks. Nearly 600 blocks have been planted already or are being cleared ready for planting in the first two sections of the palm oil settlements.

Initial production is planned for 1971, by which time it is expected about 3,500 indigenous farmers and dependents will have moved into their blocks. The average size of the blocks is 15 acres.

## Sumatra

### PREPARATION OF OLEIC ACID FROM SUMATRIAN PALM OIL

(Ir. Gan Khay Tjoan, Menara Perkebunan, 1969, 38, (7/8) 6-16)

During the last few years, The Research Department of P. T. United States Rubber Sumatra Plantations has utilised two methods of hydrolysis of local palm oil that yielded a satisfactory grade of oleic acid for use in preparation of ammonium - oleate soap as a secondary creaming agent for latex concentrate production. Both methods have been used in the pilot plant and to-date the results of the programme have been of considerable advantage to U. S. R. S. P.

## Thailand

### PESTS AND DISEASES OF OIL PALM IN THAILAND

(P. D. Turner, FAO Plant Protection Bulletin, 1969, 17 (5) 107-108)

A study was made in 1968 of the incidence of pests and diseases of oil palm in Thailand, where plantings are at present less than 1,000 hectares of Deli dura on two estates.

The most serious pest seen was the red spider mite, Tetrangelius sp. This was prevalent in nurseries and young field palms. Another pest of potential importance is the wasp, Megapis dorsata. Rats were also a potential hazard, and control measures were being applied. However, in general the pest situation was not serious but may become so if cultivation develops on an extensive scale.

The incidence of diseases appeared slight and those present were almost certainly related to the nursery technique in use. Nutrient diseases were present and could be expected in the absence of fertiliser application. Both potassium and nitrogen deficiency were noted in nurseries and field palm.

The general pattern of disease may be expected to parallel that in Malaysia, although climatic differences between the two countries, especially the marked dry season encountered in Thailand, may give rise to variation between the two countries.

### General

THE ORGANISATION OF HARVESTING IN AN INDUSTRIAL PALM GROVE  
(P. Boye and G. Martin, Oléagineux, Aug./Sept. 1969, 24 (8-9) 451-463)  
[English and Spanish summaries, 10 lines]

Harvesting is one of the most important and delicate operations where oil palm growing is concerned. The quantity of the harvested crop depends on the age of the trees, on the method of cutting, on the average bunch weight, on the ease of access to the trees, in the localisation of ripe bunches, the distance between roads and the homogeneity of the crop. It also depends on the productivity of the plantation and on seasonal fluctuation in yield.

The person responsible for this work should therefore be careful to harvest at optimum economic maturity, and continuously to adapt the frequency of the harvesting rounds and the number of staff engaged according to the ecological conditions prevailing, whilst at the same time ensuring a fair reward for the effort of the workers. This account aims at showing the different agronomic and technical factors playing their part in the organisation of oil palm harvesting. An example is given to illustrate the precision with which the operations must be supervised in order to arrive at a satisfactory economic result and to be able to deliver a high quality product to the mill.

THE USE OF ORGANO-ARSENICALS IN OIL PALM CULTIVATION  
(D. E. Barnes and W. S. Tan. Oléagineux 1969, 24 (11) 609-612)  
[English and Spanish summaries, 7 lines]

Sodium arsenite has the serious disadvantage of being toxic to man. Whilst recognising that none of the herbicides on the market at the moment presents the ideal qualities of selectivity, retentivity, cheapness and non-toxicity both for man and palm, attention has been directed to certain organo-arsenical and in particular to a monosodium salt of methanearsenic acid (MSMA). This product rapidly becomes inactive in the soil and does not accumulate in mammals. Two applications made one month apart or three applications made at fortnightly intervals (but with smaller doses) are equivalent to a single application of a mixture of MSMA + 2, 4-D + sodium chlorate. The annual costs of formulae proposed are the same or slightly less than standard treatment with sodium arsenite.

## SELECTIVE WEED KILLING IN OIL PALM PRENURSERIES

(B. Taillez, Oléagineux, 1969, 24 (10) 541-542)

[English and Spanish summaries, 4 lines]

Trials with different weed killers have shown that compounds with an ametryne basis such as Gesapax, are the most suitable for the upkeep of oil palm pre-nurseries grown in polybags. One application immediately after replanting the germinated seeds obviates the need for weeding during 3-4 months growth. Chemical weeding results in an economy of 90 per cent of the cost of maintenance compared to hand weeding.

## SOME SYMPTOMS OF BORON DEFICIENCY IN OIL PALM

(Conseils de l'I. R. H. O. No. 89, Oléagineux, 1969, 24, (11) 613-614 in French)

This article describes the symptoms, causes and methods of correction for boron deficiency, together with coloured illustrations of typical deficiency symptoms.

## WEED CONTROL IN THE OIL PALM

(Anon, World Crops, 1968, 20 (5) 21-23)

One of the biggest advantages of the triazines is the high margin of selectivity in tropical tree crops. "Gesatop" containing simazine and to a certain extent "Gesaprim" containing atrazine are ideal for weed control in oil palm nurseries where mulching is not practicable. In West Cameroon "Gesatop" has been used successfully in oil palm nurseries.

In field planted oil palm, drip circle treatments with triazine alone or in combination with a specific grass killer have given promising results in the Ivory Coast and West Cameroon. In Malaysia, sodium arsenite is used in some cases but there is scope for less hazardous chemicals such as triazines. "Gesaprim" successfully controls Empatorium odoratum and Mikania scandens as proved in recent trials in Nigeria and Indonesia, and is recommended in situations where the use of hormone weed-killers would damage young palms by accidental spraying or spray drift.

## RATS: ASSESSMENT AND CONTROL IN MATURE OIL PALMS

(R. A. Gillbanks and P. D. Turner, The Planter, 1967, 45 (519) 342-347)

A method is described whereby counts of fresh damage in oil palm are used to assess the levels of rat infestation. Census counts may be made in alternative rows or along every fourth row within a field, and it is suggested that control measures are instituted when the damage figure reaches five palms per acre. Good results have been achieved with baiting programmes using either paper-wrapped or paraffin wax based formulations.

### OIL PALM FOLIAR ANALYSIS

(Poon Yew Chin, The Planter, 1969, 45, (521) 452-457)

Fertilisers usually represent a substantial proportion of the annual expenditure on most estates. With the continued introduction of higher yielding oil palm varieties, the amount of nutrients moved from the soil will increase, so the demand for fertilisers will rise. Since expenditure involved is so high, efforts are being made to increase the precision of fertiliser recommendations as it is possible to both over and under-fertilise. One useful guide in determining nutrient requirements is the nutrient status of the leaves. However, it must be emphasised that the analytical results can only be considered as one link in the chain of data required for accurate fertiliser assessment, and the use of the results alone for recommendations is to be avoided whenever possible. The analyses are considered together with a range of other data including the type of planting material, yields, soil types, weather, age, past fertiliser application, and the experience gained from long association with oil palm cultivation.

### MANURING OF THE OIL PALM

(Ir. M. Combaire, Agric. Digest, 1968 (15) 28-33)

This article deals with the experiments carried out on oil palm, the role of the various nutrients, the interaction between nutrients and the application of fertilizers. The conditions from studies in various countries appear to show that manuring varies to a large extent according to countries and plantations. In the future, due to intensive growing, the use of selected varieties with a very high potential of production, a better control of the various inputs, manuring will get less one-sided and as a result tend to be more uniform. No doubt the local conditions will have to be taken into account when using fertilization for technical but perhaps chiefly for economic reasons.

(See also Oil Palm News, No. 7, page 16 - Editor).

### INHERITANCE OF YIELD IN THE "Deli dura VARIETY" OF OIL PALM

(R. C. Thomas et al, Euphytica, 1969, 18 (1) 92-100)

Genetic and environmental parameters are estimated by variance analysis of numerical data obtained from two programmes of plant breeding: Biparental and Cornstock and Robinson North Carolina Model. 1. The yield component total weight of fruit bunches and its subcomponents, average bunch weight and total bunch number are considered. Two experiments involving different families, within the structure of each design are analysed.

### URGENT NEED FOR PALM OIL RESEARCH

(Anon, Financial Times, 1st July 1969, page 4)

There is an urgent need for research into the marketing and general technological aspects of palm oil and kernels. The position of the oil palm industry is in some way more critical at present than that of the rubber industry, mainly because research into the marketing and uses and general technological aspects of palm oil and kernels is lagging behind the great expansion of oil palm estates.

The drastic slump in the price of oil last year made plain the urgent need for such research. No further delay should be allowed in giving to the oil palm the same expert research on marketing and technology which has been available to the rubber industry for many decades. The oil palm industry at present ranks fourth as an earner of foreign exchange for Malaysia, which is now the world's largest exporter of palm oil.

#### I. R. H. O. CONTRIBUTION TO THE DEVELOPMENT OF INDUSTRIAL PALM OIL REFINERIES IN AFRICA

(P. Boyé, Paper read at the Abijan Conference 1968, on Agricultural Research Priorities for economic development in Africa, 2, 376-385 (U.S. National Academy of Science and F. A. O. of United Nations))

Faced with the fat shortage throughout the world at the end of the Second World War, French Authorities in 1947, decided to put into effect a plan for the efficient utilisation of vast resources in the form of the natural African oil palm plantations. The study of the plan was entrusted to I. R. H. O. which was then asked to oversee the construction of eight industrial palm oil mills (one in Ivory Coast, one in Togo, four in Dahomey and two in Cameroon). This programme was carried out between 1948 and 1952.

The initial plan called for the simultaneous construction of the mills, improvement of the natural plantation conditions and their gradual replacement with selected plantations. Unfortunately the project did not progress in this respect as desired and this in turn produced difficulties in mill operation because the supply of raw materials was not always sufficient. Today, however, the selected development plans, although they are at different stages depending on the country, are well underway everywhere and the existing mills are important factors in getting the output of these plantations started satisfactorily.

#### OIL PALM CULTIVATION TECHNIQUES

(P. Renault, Paper read at the Abijan Conference 1968 on Agricultural Research Priorities for economic development in Africa, 2, 401-411)

The work carried out by I. R. H. O. at its research stations and experimental plantations has the particular objective of developing on behalf of the planters, the most efficient cultivation techniques in order to provide the plantations with the best conditions for growth and production to ensure good profitability. The report contains a brief description of the various techniques which could be tested on large areas and which involve all the operations from production to the operation of planting and replanting. It also establishes the evaluation and control criteria which practical operators need in order to make a judgment as to the state and growth of their crops.

#### SOIL AND WATER MANAGEMENT FOR OIL PALM CULTIVATION

(R. Ochs, Oléagineux, 1969, 24, (10) 34-41)

The need for developing and diversifying the agricultural economy leads to the establishment of oil palm production in regions which often are quite unfavourable in terms of soil or water.

A number of soil improvement projects (drainage, terracing) and water control projects show that the right kind of crop techniques will require very thorough prior improvement studies, in terms of the prevailing indigenous conditions. Results recently obtained in the field of irrigation also show that the outlook in the very near future for this crop cultivation method is excellent.

#### THE PROBLEM OF OIL PALM CROP PROTECTION

(J. Dubois, The Abijan Conference 1968, 2, 199-202, U.S. National Academy of Science)

Blast and nursery disease, can be effectively brought under control by putting up palm shades during certain critical periods of the year. Fusariosis, a fungal withering disease of palms, may endanger re-planting operations and sometimes ruin plantation expansions in certain regions. The selection of resistant parent stock currently seems to be the most reliable way to solve the problem. This unfortunately requires a long term effort, at least so long as a rapid and early test has not been perfected for judging the resistance of a strain. Special cultivation techniques could also offer effective aid controlling the spread of fusariosis. The symptoms associated with shoot rot should also be studied thoroughly before pathologists are able to use them effectively to determine chances of plantation success. Finally, control of pests of mature plantations is rendered more difficult by pruning the trees. Here problems of mechanisation of product adhesion and retention under tropical conditions occur, without overlooking the delicate question of a possible upset of the biological balance about which often very little is known. There will be a need for active and foresighted pathologists in all of the cultivation zones for many years to come.

#### VEGETATIVE GROWTH AND YIELD OF $F_1$ HYBRIDS E. guineensis x E. oleifera (J. J. Hardon, Euphytica, 1969, 18 (3) 380-388)

Yield and morphology of  $F_1$  hybrids E. guineensis x E. oleifera are discussed. Yield of hybrids in terms of total fruit is promising but the oil content of the mesocarp, is intermediate between the parental species and lower than in E. guineensis.

E. oleifera has a marked tendency towards the production of parthenocarpic fruits. This character is fully dominant in the hybrid. Because of this the percentage fruit per bunch in the hybrids tends to become higher than in E. guineensis, partly offsetting the lower percentage of mesocarp. The oil compositions of the parental species and hybrids are compared.

Height increment of the hybrids is substantially lower than of E. guineensis but annual frond production is approximately the same. For most morphological, vegetative and reproductive characteristics E. oleifera exhibits complete dominance over E. guineensis.

INTERSPECIFIC HYBRIDS IN THE GENUS Elaeis. CROSSABILITY,  
CYTOGENETICS AND FERTILITY OF F<sub>1</sub> HYBRIDS of E. guineensis x E. oleifera  
(J. J. Hardon and G. Y. Tan, Euphytica, 1969, 18, (3) 372-379)

The taxonomy of the genus Elaeis is reviewed. E. guineensis and E. oleifera were found to hybridize. Interspecific barriers were only partially developed, as was evident from reduced seed set in the interspecific cross and occasional incomplete pairing of chromosomes in the F<sub>1</sub> hybrids. However, vigorous F<sub>1</sub> hybrids were obtained and the scope for interspecific breeding work is promising.

MORPHOLOGY AND DEVELOPMENT OF Caelaenomenodera elaeidis  
(J. P. Morin and D. Marian, Oléagineux, 1970, 25 (1) 11-16)  
[English and Spanish summaries, 5 lines]

Caelaenomenodera elaeidis is a most dangerous pest of the oil palm in West Africa. The I. R. H. O. has undertaken a series of studies on the biology of this pest and the means of fighting it. This first article studies its life cycle, the damage it causes and the different stages in its development.

PROSPECTS OF BREEDING FOR BLAST DISEASE RESISTANCE IN THE OIL  
PALM  
(G. Blaak, Euphytica, 1969, 18 (2) 153-156)

Breeding for nursery blast resistance in the oil palm can reduce resulting loss from around 50 per cent to 1-6 per cent, when a parent is the carrier of any dominant resistant genes. At such low blast levels, most of the costly agronomic methods to reduce blast incidence need not be used. Plant material originating from the arid region in Nigeria is more blast susceptible than that from the rain forest areas.

FILTRATION OF EDIBLE OILS  
(A. G. Murray, Process Biochemistry, 1969, 4 (9) 52-56)

This article describes the use of a centrifugal dry cake discharge filter for the recovery of oil from bleaching earth after the bleaching process. Such filters are tending to replace the plate and frame presses used at present, since they are more easily integrated into continuous, automated plants and require less labour to operate.

## A HARD FAT FROM PALM KERNEL OILS FOR USE IN CONFECTIONERY PRODUCTS

(A. G. Sergent et al., Maslozhir prom., 1969 (1) 39-40 in Russian)

The authors report the results of experiments on the utilisation of various hard fats as a cocoa butter substitute in the manufacture of chocolate. The specifications for such fats (in Russia) are:- melting point  $36^{\circ}\text{C}$  maximum; solidification point not lower than  $30^{\circ}\text{C}$ . One of the promising methods of producing fats with these constants appears to be the combined fractional crystallisation and hydrogenation of fats containing a significant quantity of substituted acids of a medium molecular weight, ( $\text{C}_{12}$  and  $\text{C}_{14}$ ), for example palm kernel and coconut oils.

In experiments with palm kernel oil, fractionation was carried out without solvents and the fractions were hydrogenated. The process is described and the production of a hard fat satisfying the above constants was obtained. Chocolate prepared with this fat in cocoa powder was considered satisfactory from the point of view of hardness, texture and taste.

## TRAINING AND INFORMATION

The Bureau is prepared to advise management in the oil palm industry on the training of personnel. Details of the nationality, linguistic abilities and educational background of the candidate would be needed, together with the purpose for which training is required. Information is available about the funds which can be provided to assist in training and the Bureau can advise on how such assistance may be obtained.

The Tropical Products Institute has one of the world's best libraries of periodicals and works of reference dealing with the products of developing countries and photocopies of articles dealing with the oil palm can be provided on request. Answers to technical queries concerning the oil palm can also be dealt with; certain agronomic or engineering inquiries might have to be referred outside the Institute, but the Secretary of the Bureau would endeavour to find the best source of information.

In general, no charge will be made for any of the services provided but, if in a specific instance any charge has to be made, the inquirer will be notified in advance before he is committed to any costs.

Inquiries should be addressed to:

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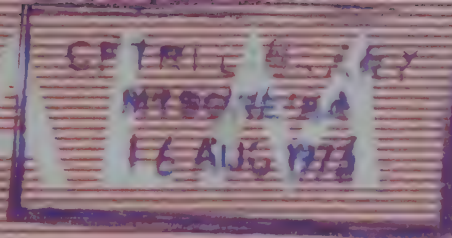
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# OIL PALM NEWS



PALM ADVISORY BUREAU, TROPICAL PRODUCTS INSTITUTE, LONDON.

## EDITORIAL

Any possibilities for increasing the end-usage of palm oil will be of interest to producers and sellers. Fractionation of the crude or refined oil into high and low melting point materials is one way of achieving this and two articles on the subject contributed by commercial firms will be found in this issue preceded by an introductory note by the Editor.

There was a good response to the questionnaire which was sent out with the 13th issue, a 22 per cent return being very encouraging and clearly indicates a considerable interest in the continuation of the publication. Some useful suggestions were received and we are particularly grateful to those who promised articles for future issues and the Editor will be following up these offers in due course where he has not already done so. More details of the response to the questionnaire appear elsewhere in this issue. A suggestion that the abstracts be printed on one side of the paper has been adopted in this issue since this enables readers to paste them on cards for filing where desired.

In order to assist readers who may wish to secure reprints of the original papers direct from the authors, the names and addresses of authors' organisations are being incorporated in the abstracts where the details are available.

Letters from readers covering items published in Oil Palm News which might form the basis of a "correspondence column" would be welcome.

The final date for the receipt of articles and comments for the 16th issue due to appear November 1973 is the 7th September.

## CONTENTS

	Page
Editorial	(i)
Response to Questionnaire sent out with <u>OPN</u> No. 13	(iii)
The Assessment of Palm Oil Quality	1
Production of Hydrolytically Stable Palm Kernels	2
Some Impressions of the Oil Palm Industry in South Asia and the Far East	10
Palm Oil Fractionation - an Introductory Note	16
Palm Oil Crystallisation and Fractionation	18
Salad Oil and Edible Fats from Palm Oil by a New Fractional Crystallisation Method in iso-Propyl Alcohol	24
Oil Palm Market Survey	30
Recent Publications	35
Training and Information	40

# RESPONSE TO QUESTIONNAIRE SENT OUT WITH OPN No. 13

The analyses are based upon 174 replies received by the end of 1972 or 22.0 per cent of the total number sent out with OPN.

1. Roughly how often do you find information in OPN not available to you from any other source?

Often	70
Sometimes	52
Never	10

2. Which sections are most useful to you?

Articles	117
Book notices and reviews	56
Market Survey	52
Abstracts	75

3. Is the periodical presented in an acceptable and readable form? Please comment.

Unqualified "Yes"	64
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Qualified "Yes"	48
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Of which:

Favorable	34
Stronger binding needed	2
Greater detail needed	2
More illustrations	1
More commercial aspects and advertisements	1
More agronomy articles	1
Review a different producing country in each issue	1
Statistics on main producing countries	1
Sub-divide Market Survey into palm oil, palm kernel oil and palm kernels	1
Include monthly prices of palm oil and palm kernel oil	1
Abstracts in greater detail	2
Abstracts in double columns	1

4. Can you suggest areas of the oil palm industry for which you would like greater coverage?

Rural and Industrial Processing	31
Agronomy and cultivation	23
Markets and economics	22
Pests and weed control	6

5. Are there other members of your staff who should be added to our mailing list?

Total additional copies requested 119

6. Would you be willing to provide an article for OPN? If so, on what topics?

Rural and Industrial Processing	13
Agronomy and cultivation	14
Markets and economics	3
Pests and weed control	1

# THE ASSESSMENT OF PALM OIL QUALITY - INTERNATIONAL COLLABORATIVE WORK

by J.A. Cornelius

The collaborative work of the Palm Oil Sub-Committee of the IUPAC Oils and Fats Section referred to in Oil Palm News, 1972, No. 13, page 1 was reviewed at its meeting at Chester, England, in September 1972.

The samples circulated comprised three commercial crude palm oil samples of low, high and intermediate total oxidation respectively as determined from the peroxide and p-anisidine values. Three further samples were obtained by heating a portion of each of the above oils at 200 or 250°C under vacuum in order to break down a proportion of the peroxides thus increasing the amount of secondary oxidation products.

Fifteen collaborators in Belgium, France, Germany, Netherlands, New Zealand, Sweden and the UK took part in the analyses for ffa, copper, iron and carotene content and for peroxide and p-anisidine values. The results showed good agreement for ffa, fair for iron and carotene and poor for copper. There was a wide spread in peroxide values, especially for the samples with lower peroxide levels, possibly due to over-heating the samples before testing. The agreement for p-anisidine was good considering the unfamiliarity of the method. It was considered that the "Totox Value" (p-Anisidine Value + 2 x Peroxide Value) gave useful information on the state of oxidation although some users are still wanting bleachability tests. It was proposed that IUPAC publish a choice of the methods for bleachability which are available, together with a note on the limitation of use.

It is not proposed that the Palm Oil Sub-Committee carry out any collaborative tests in 1972-73 since the Vegetable Oils Technical Committee of the Rubber Growers Association are embarking on a collaborative work programme using oils originating from various Malaysian estates. The Sub-Committee will await the results of this study.

# PRODUCTION OF HYDROLYTICALLY STABLE PALM KERNELS \*

by A.J. Clegg and Y.C. Teh, Harrisons & Crosfield, Oil Palm Research Station, Banting, Malaysia.

## Introduction

The occurrence of lipolytic microorganisms in palm kernels, and their effect on the quality of the kernel oil are well known. For example, pathological examination of kernels in Nigeria has shown the presence of several lipolytic microorganisms which infect kernels under conditions prevailing there. Lipolytic microorganisms have also been cited as the cause of deterioration in Congolese palm kernels, and two of these, Rhizopus cohnii and Petasospora rhodanensis have been isolated and studied in detail.(2, 3)

The abundance of lipolytic microorganisms present in factory air, and at various stages during the process of recovery of palm kernels in Malaysia has been reported by Turner (4) who concludes that infection of palm kernels by lipolytic microorganisms after the kernel has been freed from its shell is normal in Malaysia, as elsewhere.

Examination here of a large number of samples of Malaysian kernels has confirmed this, and the effect of infection on the storage stability of kernels has been demonstrated.

The removal or deactivation of lipolytic microorganisms is of prime importance in preventing degradation of kernels during storage. Drying and sterilisation of kernels may both have beneficial effects in terms of minimising lipolytic microorganism infection (4, 3), and it has been demonstrated here that by sensible application of both techniques during kernel production, it is possible to inhibit microorganism growth and hydrolytic activity to such an extent that the kernels produced show negligible free fatty acid (ffa) rises during storage.

## Examination of kernels for lipolytic microorganism infection

The kernels for examination were removed from their sterile containers in a sterile room, and each kernel was smeared across the surface of a previously prepared sterile nutrient medium contained in a petri dish. The medium used consisted of malt extract agar containing 5% glyceryl tributyrates. After smearing, the lids were replaced on the petri dishes which were then placed in an incubator at 32°C, and allowed to incubate for 4 days. After that time the plates were removed from the incubator and inspected. Infection transferred from the kernel to the nutrient medium during smearing was made obvious by the appearance of a visible growth on the medium after incubation. Where the infection was lipolytic this was indicated by a clear area around the growth, caused by lipolysis of the glyceryl tributyrates. Where kernels were not infected, the media on to which they were smeared developed a slight uniform opacity during incubation and there were no signs of fungal growth.

## Determination of free fatty acid

Kernels for ffa determination were cut into slices of approximately 2 mm thickness using secateurs, and then minced in a grinding mill. Oil was extracted from the minced kernels

\* French version published in Oléagineux, 1972, 27, (2), 101 - 104.

in a soxhlet. After removal of solvent from the extracted oil, the ffa was determined by titration of an alcoholic solution of the oil with N/20 aqueous potassium hydroxide using phenolphthalein indicator. The ffa was expressed as lauric acid.

### Determination of Moisture and Oil Contents

Kernels for moisture determination were sliced and ground. After weighing, the ground meal was dried to constant weight at  $105^{\circ}\text{C}$ . Moisture content was calculated from the weight loss on drying. 15 g of the dried meal was then accurately weighed into a soxhlet extraction thimble and extracted for 10 hrs. using petrol solvent (boiling range  $56^{\circ}-70^{\circ}\text{C}$ ). The soxhlet thimble was then removed from the soxhlet, allowed to drain, heated at  $80^{\circ}\text{C}$  for 1 hour to remove solvent, and subsequently reweighed. Oil content (on dry basis) was calculated from the weight loss on extraction.

### Effect of Infection on Kernel Stability

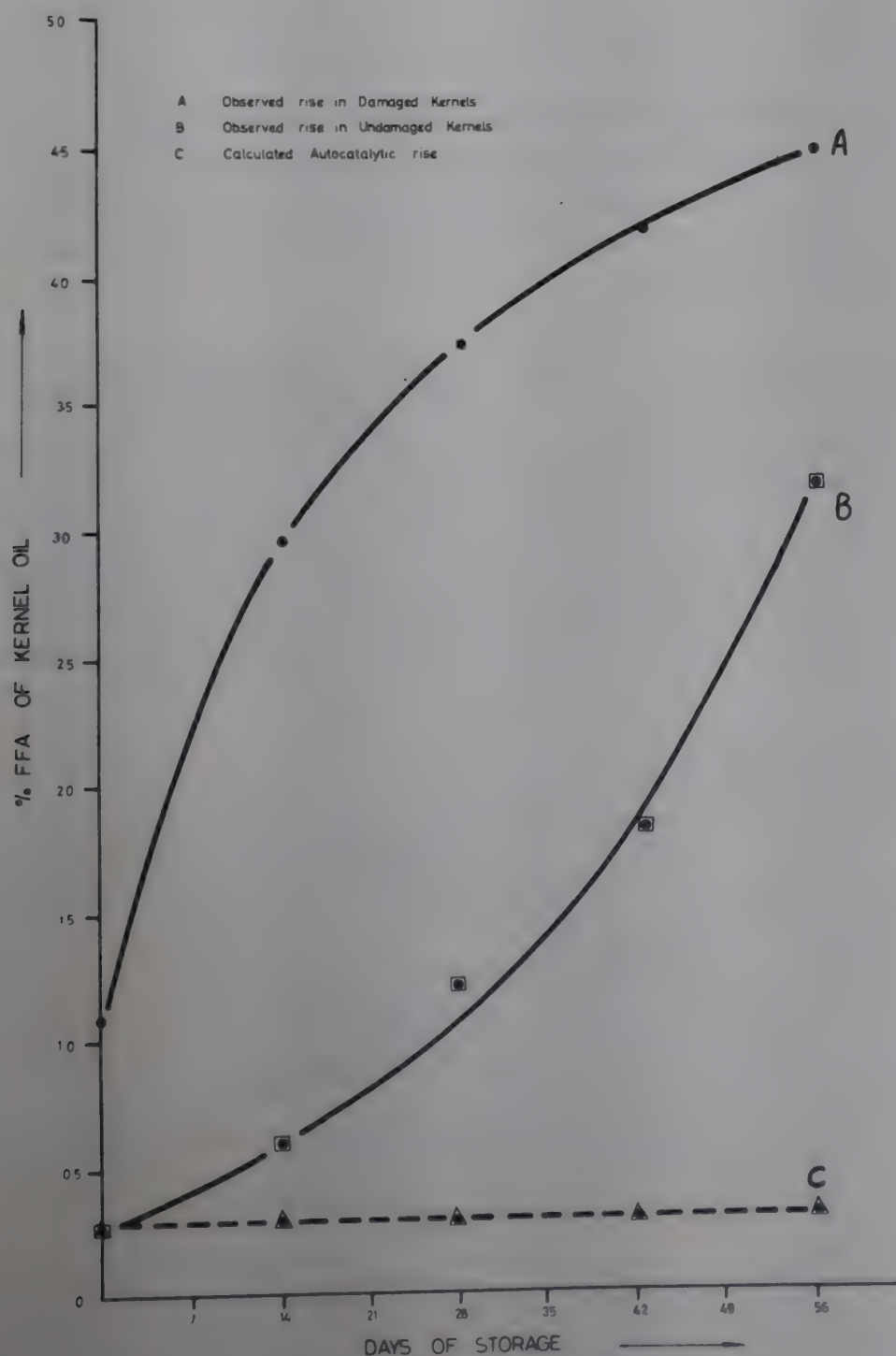


FIG.1 - FFA RISE IN INFECTED KERNELS DURING STORAGE AT  $28 \pm 2^{\circ}\text{C}$

Figure 1 shows the actual ffa rise during storage of typical batches of infected Malaysian kernels stored at  $28^{\circ} \pm 2^{\circ}\text{C}$ , shortly after being freed from their shell. Curve A shows the ffa rise in undamaged kernels, and curve B that in damaged kernels. Both are compared with the calculated autocatalytic ffa rise at that temperature (curve C). The predicted autocatalytic ffa rise is very slow owing to the low initial ffa of the kernel oil (0.25%).

As a result of the catalytic effect of lipolytic enzymes produced by infecting microorganisms the observed ffa rise in both sets of kernels is very rapid in comparison to the autocatalytic effect. This is particularly so in the case of damaged kernels, where one must assume that damage to the protective outer skin of the kernel allows easier access of infection to the oil bearing interior.

The initial ffa of the samples was measured approximately one week after the kernels were freed from their shells, and it is interesting to note that in that short time marked differences in ffa had already arisen between the damaged and undamaged kernels.

### Sterilisation of Kernels

The lipolytic microorganisms reported in Congolese kernels were thermolabile, and thus exposure to a temperature of  $80^{\circ}\text{C}$  for several minutes resulted in their complete destruction. Investigations here have demonstrated that lipolytic infection in Malaysian kernels is also thermolabile, although slightly more severe conditions than those mentioned above are necessary for complete destruction.

The results shown in Table I were obtained when 7 subsamples were taken from a main sample of kernels, and sterilised under the different conditions shown. Immediately after sterilisation, the kernels were left in air for 5-10 minutes to allow surface moisture to evaporate, and then transferred to air-tight sterile containers, which were then taken to a sterile room. There the containers were opened, ten kernels removed from each subsample and assayed separately for lipolytic microorganisms. Table I shows that exposure to temperatures in excess of  $90^{\circ}\text{C}$  for 6 minutes resulted in complete destruction of microorganisms on the kernel surface. Under more severe conditions sterilisation was more rapid.

TABLE I: Sterilisation of kernels

Method of Sterilisation	Conditions of Sterilisation			% of kernels infected
	Temp. $^{\circ}\text{C}$	Pressure	Time (min)	
None (control)	-	-	-	80
Blasting with saturated steam	100	Atmospheric	3	50
Immersion in hot water	90-100	Atmospheric	3	30
Blasting with saturated steam	100	Atmospheric	6	0
Immersion in hot water	90-100	Atmospheric	6	0
Autoclave	122	15 lb/sq.in	3	0
Autoclave	122	15 lb/sq.in	6	0

Drying of Kernels

In order that oilseeds may support microorganism growth they must contain in excess of 14% moisture calculated on the basis of the non-oily portion of the seed (5). Thus the higher the oil content of the seeds the lower must be the moisture content, on whole seed basis, below which the kernels are safe from infection. The oil content of Malaysian kernels seldom exceeds 53% on dry basis, so that generally if kernels are dried to moisture contents less than 7.0% on whole kernel basis, they will be unable to support microorganism growth. The tests described below, however, indicate that drying kernels to below the appropriate moisture content may not give the reduction in ffa rise during storage that could perhaps be anticipated.

A batch of undamaged commercially produced kernels having an average oil content of 50% and moisture content of 7.0% which is below the level at which such kernels can support microorganism growth, were stored in a partially air-conditioned room at  $28^{\circ} \pm 2^{\circ} \text{C}$ , and estimated relative humidity less than 80%. A subsample of the batch was also taken and sterilised for 10 minutes at  $122^{\circ} \text{C}$  in an autoclave, and then put to store alongside the unsterilised kernels. Samples were removed fortnightly, from both sets of kernels, for ffa analysis, and moisture content determination. Figure 2 shows the ffa rise in both sets of kernels during storage.

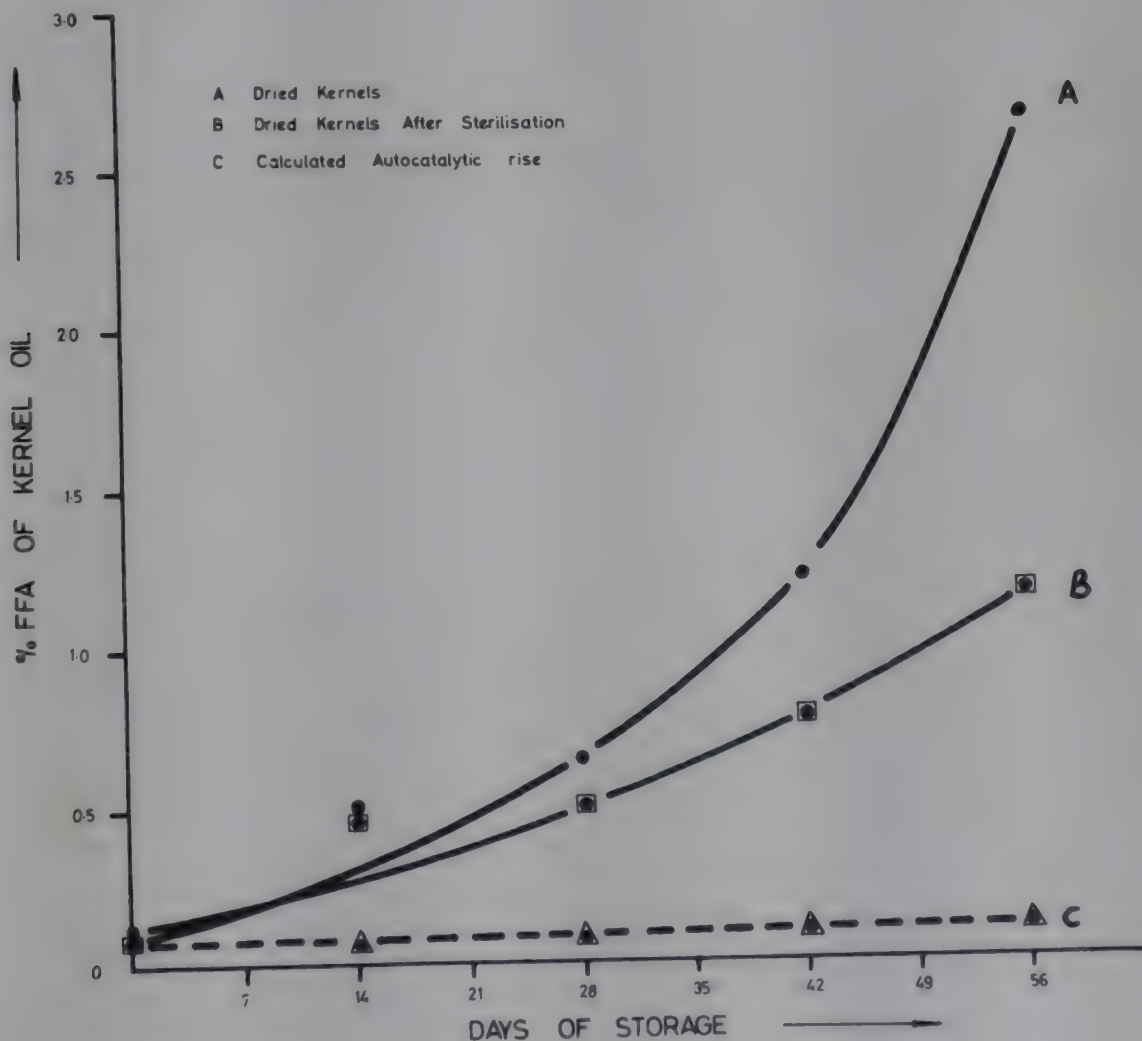


FIG.2 - EFFECT OF STERILISATION ON FFA RISE IN DRIED KERNELS

The ffa rise shown by the unsterilised kernels (Curve A) is considerable in view of the fact that they should no longer be able to support microorganisms and the ffa rise might thus be expected to be close to that for purely autocatalytic hydrolysis (Curve C). Curve B shows that sterilisation of these kernels produced some reduction of ffa rise, but still has not reduced it to the level expected for autocatalytic hydrolysis.

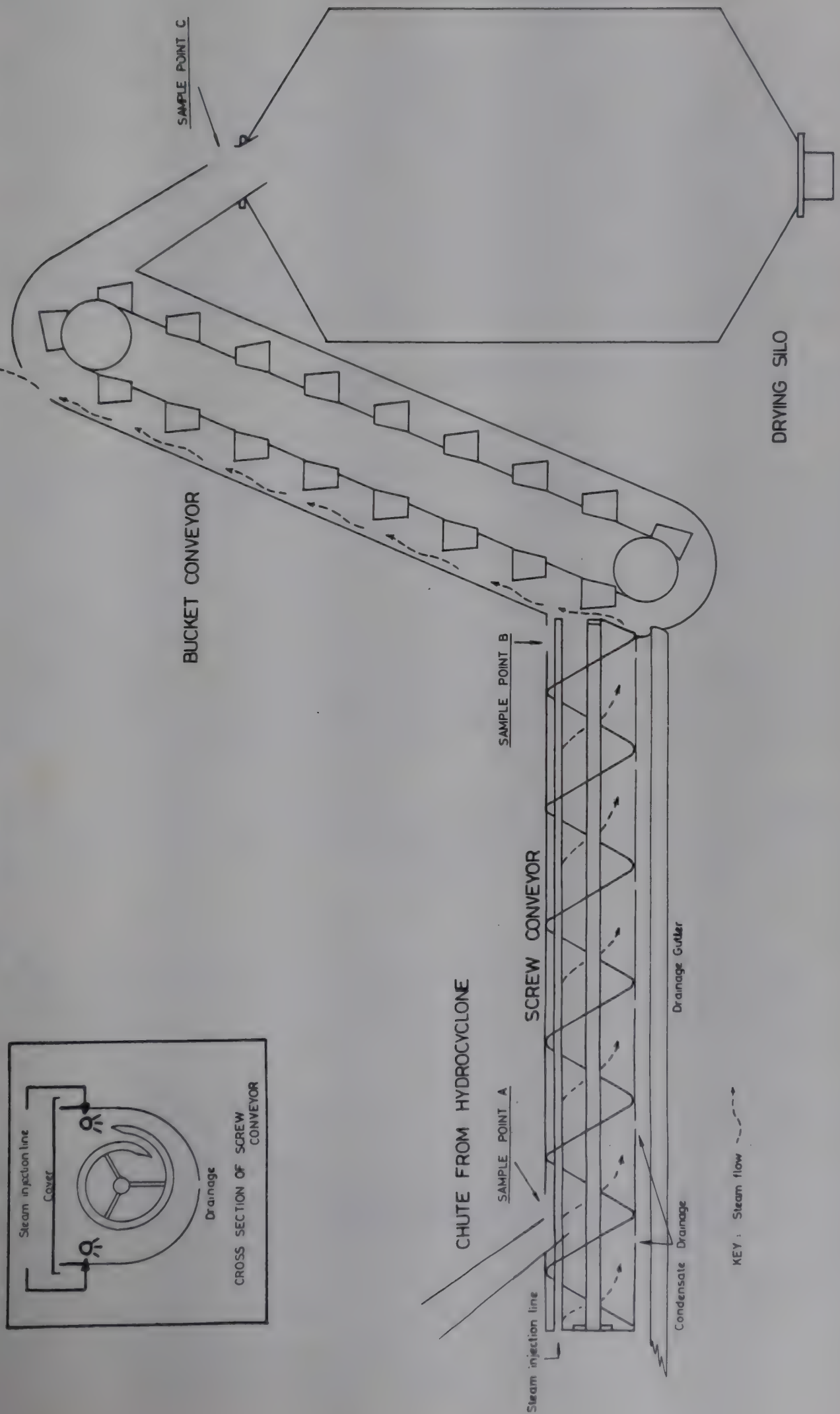
Since the moisture contents of the kernels during storage never exceeded the limit above which microorganisms would develop, and sterilisation of the kernels under conditions known to be lethal to the microorganisms failed to reduce the ffa rise to the level expected for purely autocatalytic hydrolysis, it must be concluded that the ffa rises observed are not attributable to lipolytic microorganisms infecting the kernels during the time of storage. It is however, possible that lipolytic microorganisms which infected the kernels prior to drying and sterilisation produced a lipase that is viable under conditions lethal to its parent microorganism. The resilience of this lipase is demonstrated by the fact that it could not be completely deactivated during 10 minutes sterilisation at 122<sup>0</sup> C.

These findings are consistent with findings by Loncin and Jacobsberg (6), who found that under dry conditions, lipase from Rhizopus cohnii, a microorganism found on Congolese kernels, remains active and heat stable.

### Stabilising Palm Kernels

It is obvious from the foregoing investigations that while microorganism growth is easily checked, the damage arising in palm kernels as a result of infection can persist long after infecting microorganisms are removed. For the production of stable kernels it is therefore necessary to ensure that kernels do not become infected between the time they leave the sterile conditions of their shell and the time their moisture content is reduced to a safe level. A simple system (Fig. 3) for the production of stable kernels has been tried at one mill in West Malaysia.

FIG. 3 - DIAGRAM OF SIMPLE SYSTEM OF KERNEL  
STERILISATION



Kernels leaving the hydrocyclone, where they are separated from their shells after the nutcracker, are delivered into a horizontal enclosed screw conveyor by which they are conveyed to an enclosed bucket conveyor which then lifts the kernels to the top of the drying silo and deposits them there. Steam injection into the screw conveyor was achieved by means of two steam lines running along the length of the conveyor, parallel to the screw shaft. Holes were drilled at regular intervals along the steam lines so that steam injection points were evenly distributed along the length of the conveyor. Kernels were sterilised by the injection of saturated steam as they moved along the conveyor. Retention time for kernels in the conveyor was 5-6 minutes. Steam injected into the screw conveyor finds its outlet through an opening in the top of the bucket conveyor, so that conditions in this conveyor are also sterile. Samples taken from sample points A, B and C (Fig. 3) were assayed for microorganisms and the results are shown in Table II.

TABLE II: Removal of Infection During Kernel Production

	SAMPLE POINT A (Hydrocyclone shute)	SAMPLE POINT B (End of screw conveyor)	SAMPLE POINT C (Top of drying silo)
% Infected kernels	80	0	0

As can be seen, samples leaving the hydrocyclone were already heavily infected, but, were effectively sterilised in the screw conveyor and remained sterile into the drying silo. Samples of sterilised kernels which had been dried to a safe water content in the silo were then divided into damaged and undamaged kernels, put on storage, and their ffa measured fortnightly. The results are plotted graphically in Fig. 4.

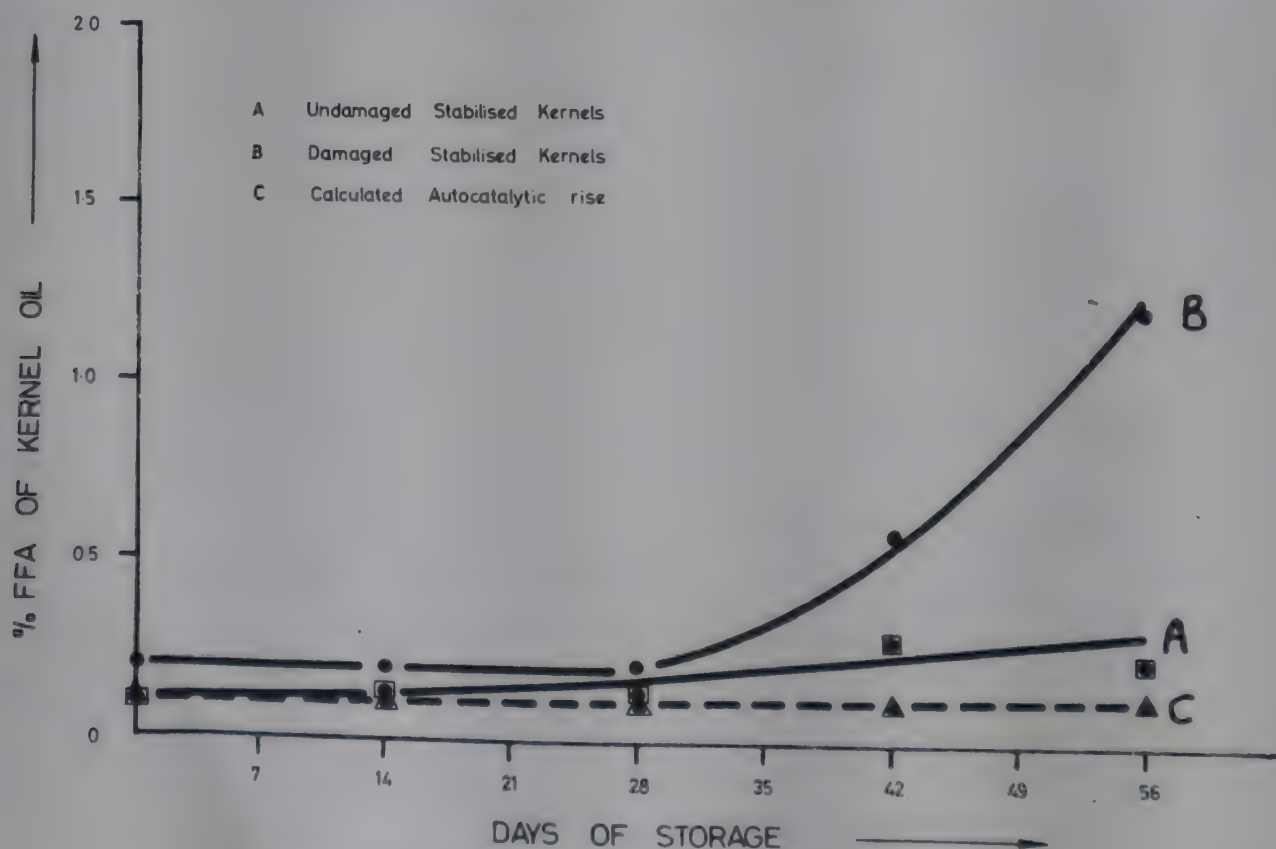


FIG. 4 - FFA RISE IN STABILISED KERNELS DURING STORAGE AT  $28 \pm 2^\circ\text{C}$

Fig. 4 shows that the kernels are quite stable, the ffa of the undamaged kernels being only 0.25% after two months storage. The rate of ffa production was quite close to that predicted for autocatalytic hydrolysis. In the case of damaged kernels, the ffa rise over the period was more considerable, the ffa after two months being 1.2%. However, a large degree of stabilisation has still been achieved since typical ffa values found in damaged kernels which have not been sterilised prior to drying are in the region of 4% after two months storage.

### Summary

Lipase produced by lipolytic microorganisms, which are present in factory air and infect kernels, results in enzymatic hydrolysis of kernel oil, and is thus responsible for the ffa rises experienced during storage of palm kernels.

Autocatalytic hydrolysis, if it was the only factor involved, would result in considerably slower rises than those normally observed.

Lipolytic microorganisms cannot develop in kernels which are dried below a critical safe maximum moisture content, but although reducing the moisture contents of kernels below this level will check the growth of microorganisms, it is possible that on kernels which are infected before drying, the lipase produced by the infection will remain active even after destruction of the microorganism by drying, and will not be destroyed by simple methods of sterilisation.

Sterilisation of kernels at temperatures in excess of 90°C for 6 minutes, as soon as possible after they are freed from their shell, minimises infection prior to drying to a safe water content and enables the production of kernels which after drying are stable during storage. The best results are observed with undamaged kernels.

Sterilisation equipment need not be complex, as long as the above temperature and residence time are achieved, and a simple system is described here which may be applicable to a number of mills.

### Acknowledgement

The authors wish to thank Messrs. Harrisons & Crosfield (M) Sdn. Bhd. for permission to publish this article.

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# SOME IMPRESSIONS OF THE OIL PALM INDUSTRY IN SOUTH ASIA AND THE FAR EAST \*

by J. A. Cornelius

Visits were paid to Sri Lanka (Ceylon), India, Thailand, Papua New Guinea, Khmer Republic (Cambodia) and West Malaysia in the course of participation in a four-man consultative mission for the Asian Industrial Development Council, organised by the United Nations Economic Commission for Asia and the Far East (ECAFE) and extending over April, May and June, 1972. The purpose of the Mission was to examine the existing state of development of the oil palm industry in the countries visited and to advise the Governments on future development, taking into account local circumstances and export prospects.

## Sri Lanka

The vegetable oil economy of Sri Lanka is at present based entirely upon coconut production (about 2,700 million nuts per annum) and consumption (domestic consumption being nearly 70% of the total production, the rest being exported as copra, coconut oil or desiccated coconut). Small amounts of sesame, mowrah illipé (mae), cottonseed, and rubberseed oils are also produced, and the production of soya beans and sunflower seed are intended in the near future. With the low world price for copra and coconut oil, there is much concern for the future prospects for coconuts and for this reason there is some interest in possible diversification into oil palm since palm oil does not have the same disadvantages of being a highly saturated fat, and, furthermore, it can be fractionated into an even more unsaturated (liquid) fraction. Also, palm oil and tallow have been imported in annual amounts of up to over 1,500 tons and 4,000 tons respectively, but these imports have been greatly reduced in recent years with a view to saving foreign exchange. There is therefore interest in developing a small oil palm industry both to substitute imports of palm oil and tallow, and also to substitute coconut oil to some extent. This could be done, for example, to the extent of 50% in hydrogenated fats and margarine, and could be used also in the manufacture of soap, thus releasing more coconut products for export. At 1971 consumption rates, this would amount to a total of about 9,000 tons per annum and it is estimated that the technically feasible internal consumption will be about 11,500 tons of palm oil by 1982.

All the areas considered for oil palm planting lie in districts to the South-east of Colombo, since these are most suitable climatically.

The first plantings on a commercial scale were made in 1968 by the Nakiadeniya Group Rubber Estates in Udugama, Galle District, the Perth Estate in Horana, and the Lowmont Estate - both in the Kalutara District. At the time of the Mission's visit, 350 acres (140 ha) of palms had been planted at Nakiadeniya. These showed good healthy growth and were fruiting well but most of the palms planted after 1968 are on very steep slopes with inadequate terracing and are considered to be unsuitable for commercial oil palm cultivation. Crows were attacking the fruit on the palms and could become a pest in plantations. Although it has been proposed to plant up to 2,500 acres in the area, it is doubtful whether suitable land

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\* The information contained in this paper is drawn from the report of the AIDC Consultative Mission on the Oil Palm Industry, which was carried out under the auspices of the United Nations Economic Commission for Asia and the Far East, document No. AIDC (8)/1 dated 30th October, 1972.

is available on the estate. However the existing plantings can be regarded as a pilot scheme, and experience gained from them should be of benefit in the development of the industry elsewhere in Sri Lanka. A proposal has already been made for processing fresh fruit bunches (ffb) at the Estate using a mechanised hydraulic press of 0.75 tons ffb per hour capacity on the basis of present and projected plantings, up to 1973 when a total of 588 acres (211 ha) will be under oil palm. One of these presses will handle the entire harvest, at least until 1977, but a further press will be required some time thereafter. The plantings in the Kalutara District are each 1-acre (0.4 ha) trial plots, the one at the Lowmont Estate comprising healthy looking plants, growing well, only a few palms showing signs of nutrient deficiency, possibly in potassium. Practically all these palms were bearing. The Kalutara District seems likely to be the more suitable for oil palm cultivation in the future, where an area of some 3,000 acres (1,200 ha) within a 5-mile radius should be available, although further studies of the area will be necessary.

## India

With a total vegetable oil production estimated to be 2 million tons per annum, India is the third largest producer in the world. However, since 1964 it has been a net importer of fatty oils, particularly of the hard fats such as palm oil and tallow, mostly for the manufacture of soaps and fatty acids. Nevertheless, the need to conserve foreign exchange has resulted in a decline in palm oil imports and the growth of population compared with increased domestic vegetable oil production means that the demand for vegetable oils has outstripped supplies. Thus, the need for the development of an oil palm industry was found to be greater in India than in any of the other countries visited.

Only the southern part has a suitable climate for oil palms and the areas under consideration which were visited were in the states of Mysore, Kerala and Tamil Nadu. A project for the development of 6,000 acres (2,400 ha) of oil palm in Little Andaman Island to be executed by the Forest Department of the Little Andaman and Nicobar Island Administration had been put forward for development between 1973 and 1978, but the Mission was unable to visit the area during the time available.

In Mysore State at Sampaji Reserve Forest in the Sullia hills, a total of 1,232 palms had been planted in an area of about 22 acres (9 ha) between 1968 and 1971. However, growth was not satisfactory and the rainfall for the area is so unevenly distributed with a dry period of 4 months and 50% of the rainfall occurring in only 2 months of the year, that attempts at oil palm cultivation in Mysore state would appear to be inadvisable.

The Kerala State Plantation Corporation Ltd., commenced oil palm planting in April 1972 at Barathipuram in the Yeroor Reserve Forest area in the Quilon District, of nursery plants from seeds sown in July 1971. The area totals 5,000 acres (2,000 ha) of which 278 acres (112.4 ha) had been planted at the time of the visit. It is planned to run the project on a nucleus estate basis with 2,000 acres (800 ha) of smallholders. The palms were showing normal growth and some had already started flowering, although intensive maintenance was not carried out. The Mission noted that some 50% of plantings were on slopes of more than 20° which will result in high harvesting and maintenance costs. It was considered that contour planting on continuous terraces should be carried out in such hilly areas, and that continuous dykes should be established on slopes of less than 15° to prevent erosion. With

the present and projected planting - up to 5,000 acres (2,000 ha) by 1975/76 - annual ffb yields have been computed to be from 100 tons in 1974 up to 24,000 tons in 1983 by which time all these plantings should be up to the steady-bearing state. Thus the eventual milling capacity will need to be able to cope with 9 tons ffb per hour on a 3-shift basis.

At the Oil Palm Research Station, Thodupuzha (see Oil Palm News, May 1968, No. 5, 6-9) D x D, D x P and D x T materials from Malaysia and Nigeria have been planted over 60 acres (24 ha). With adequate staffing, supervision and maintenance, this station should become an effective centre for the production of improved varieties for the local conditions. At present, with a hand hydraulic press and ancillary equipment of the type developed at the Nigerian Institute for Oil Palm Research, oil was being produced for sale to local soap manufacturers to the extent of about 20 tons per year.

Other areas which have been considered suitable in Kerala State were Kuthalli, Vazhachal, and Konni/Ranni Reserve Forests, but the Mission could not visit these. Only limited soil studies of these areas appear to have been carried out, and the topographical map suggests that in general they are too hilly and it appears that a detailed feasibility study needs to be mounted before the establishment of oil palm cultivation is considered.

In Tamil Nadu State, 24 palms were planted in the Kanyakumari District in 1969 on a cocoa pilot centre in Pechiperai. In spite of lack of maintenance and fertilisation, the palms appeared healthy. The areas likely to be available for cultivation total 3,000 acres (1,200 ha) of which some 1,000 acres (400 ha) are separated from the main area by a distance of some 16 km (10 miles) of road, which raises the question as to how to deal with the processing. A possibility of having a main factory sited in the larger area and a subsidiary factory with facilities for sterilisation, stripping, digestion, oil extraction and separation of nuts from fibre and the crude unclarified oil and nuts transferred to the main factory daily for final processing was suggested. The soil in the area has a high proportion of gravel and sand and cultivation measures to improve its quality by planting Leguminosae (eg Crotalaria tephrosia for mulching and Pueraria javanica as cover crop) should be carried out if an oil palm plantation is to be successful. Taking into account local socio-economic circumstances and climatic conditions, there seems to be a good case for the establishment of such an industry in this State.

### Thailand

The per caput consumption of fats and oils in Thailand is computed to be less than 3 kg per annum which is far below the minimum nutritional requirement and lower than all the other Asian countries, although there are indirect sources of fat intake in the local diet. Lard is the traditional source of fat, while coconut oil is the vegetable oil produced in the largest quantity, followed by rice bran, groundnut and soya bean oils. The scope for expansion of the local vegetable oil market appears to be limited. According to one estimate, consumption will increase by about 20,000 tons between 1970 and 1980. The oil palm industry is new to Thailand, although its establishment seems to have been considered by the Government in 1965 following a mission from IRHO.

The main developments to date have been the Government settlement scheme in Satul Province, and a private enterprise scheme in Krabi Province. The Government scheme

commenced with 20 acre (8 ha) in 1969, 1,897 acres (768 ha) in 1971 and 600 acres (240 ha) in 1972. Each settler was given 7.2 acres (2.9 ha) of which 0.8 acres (0.32 ha) were for house and garden, 2.4 acres (0.96 ha) for subsistence crop and 4 acres (1.6 ha) for oil palm.

The palms on the demonstration plot showed normal growth and were well in bearing, but the 1969 planting had been neglected, and the 1971 planting had been for the most part planted too late in the season. If the scheme is to be successful, it must be reorganised on estate lines with the settlers employed as labourers, as has been found to be necessary with such ventures in Malaysia. There is a lack of data on climate and soils in the area, but the United Kingdom firm of Huntings Technical Services Ltd., are currently engaged in a soil survey, the results of which will no doubt be taken into account with regard to future plantings. On the basis of present and projected plantings up to and including 1972, it is estimated that, provided sufficient care and maintenance of the crop are applied immediately, the estate factory will have to process up to 3 tons ffb per hour by 1974 and 6 tons ffb per hour by 1976.

The private enterprise scheme commenced in 1969 and, to date, 2,863 acres (1,159 ha) have been planted with the intention of planting 400 acres (160 ha) per year up to a total planted area of 8,000 acres (3,200 ha) with the eventual addition of smallholders. The factory, which is planned for 1973, will have a total capacity of 20 tons ffb per hour, the site was already in preparation at the time of the Mission's visit.

At the Nai Chong Rubber Experiment Station, 20 acres (8 ha) were planted in 1970 with Malaysian material consisting of D x D, T x T and D x P. These palms could be the foundation of a breeding station for future planting material.

### Papua New Guinea

The development of an oil palm industry in Papua New Guinea commenced in 1967 on the island of New Britain, reportedly as the result of a World Bank mission 2 years earlier. 5 or 6 acre (2 or 2.4 ha) oil palm trial plots were laid down from 1966 in 5 mainland localities, 2 in New Britain, 1 in New Ireland and 2 in Bougainville Island. These have each been planted with 4 progenies from Harrison's and Crosfield Ltd., and 4 from Chemara in Malaysia. Each locality was reported to show very good growth but for one in the Northern District at 1,800 ft (550 m) altitude, the growth was slow. Of these plots only those at Bubia and Popondetta were visited. The Administration of Papua New Guinea are considering the possibility of local outlets for palm oil in the manufacture of soap and margarine, but at present the whole of the output is exported. Palm oil production started only in the latter part of 1971, and amounted to 1,055 tons by the end of that year, the first shipment being in November. It is estimated that by 1979/80 the annual production of the present planted areas, which are all around Cape Hoskins in West New Britain, will be over 51,000 tons of palm oil and exceed 8,000 tons of palm kernels. The plantings include a 5,034 acre (2,037 ha) nucleus estate, 8,140 acres (3,294 ha) of smallholders, 803 acres (325 ha) of village plantings and 689 acres (279 ha) of other plantings. The nucleus estate and the processing factory have been established and are run by the New Britain Oil Palm Development Ltd., a partnership between the Administration and Harrisons and Crosfield Ltd., the latter being the managing agents. The factory is designed to cover eventually 25,000 acres (10,000 ha) and to process up to 50 tons ffb per hour, but at present it is processing only 10 tons of ffb per hour using two automatic hydraulic presses.

With young volcanic soils of very high fertility, the palms seen on the settlement scheme were well developed, extremely high ffb yields being experienced, 8 tons ffb per acre (20 tons ffb per ha) per annum being quoted as average and oil to bunch ratios of 20% were being obtained in the first harvesting year. The oil content of the kernels was also unusually high at 55 to 56%. The settlements are well organised, each farmer being responsible for his own 15 acre (6 ha) plot, of which he must plant 4 acres (1.6 ha) with oil palm in the first year of his occupancy and another 4 acres in the second year. An agricultural officer is responsible for one sub-division consisting of about 8 sections of between 30 and 40 plots each. Fruit collections are made weekly from each bearing plot, payment to the farmer being according to ffb weight. One settler's ffb weight at one collection from 4 acres in the first year of bearing amounted to 750 kg.

The Administration and the South Pacific Oil Palm Development (PTY) Ltd., have drawn up a development programme along similar lines for the Bialla area in East New Britain, where a total of 15,400 acres (6,230 ha) is to be planted over a 5-year period.

The Mission visited the Popondetta area in the Northern District of the mainland where there are 2 trial plantings of 1.5 acres (0.6 ha) at the Popondetta Agricultural Training Institute, and 2 acres (0.8 ha) at Saiho with yields from the latter of 8 to 14 tons ffb per acre (20 to 35 tons ffb per ha) in the 2nd year of harvesting. The feasibility of a 3rd project in this area is to be examined in the near future.

#### Khmer Republic (Cambodia)

No commercial plantings of oil palm have been started or planned at the date of the visit but some experimental plantings have been carried out in the Kampong Som area to the south-west of the country, since 1958 although all of them have been neglected, and no proper records have been kept. Like the neighbouring countries, lard is the traditional principal fat consumed for culinary purposes, although about 500 tons of vegetable oil (coconut and groundnut oil) were produced in 1969 and 2,200 tons of vegetable oils, mostly coconut oil, were imported in the same year. Up to about 2,000 tons of refined deodorised rice bran oil per year could be produced in Phnom Penh if supplies of bran were available regularly and in sufficient quantity.

During a 1-day trip to Kampong Som, visits were paid to the rubber estate of the Société Cambodienne des Cultures Tropicales (SCCT), The Coconut Research Station at Tuk Sap, and two private coconut estates. At the SCCT Estate, 100 Deli dura palms were planted in 1958. In spite of the poor soils and complete neglect, the palms were bearing fruit. A similar situation was found at the Tuk Sap Experimental Station where 40 D x T oil palms were planted in 1961 by IRHO on poor acid soils. Another experimental planting in 1970 of 30 acres (12 ha) of D x P material from Africa was in an area which the Mission was unable to visit.

In view of the lack of data on the performance of the experimental plantings, a new trial planting of about 25 acres (10 ha) of new high yielding planting material in the Kampong Som area is necessary before arriving at a decision to plant on a larger scale. With a 4-month dry period, climatic conditions are not ideal but there is a need for crop diversification and for providing local employment in the area. Therefore if the trial is successful, the

establishment of some 2,500 to 3,710 acres (1,000 to 1,500 ha) of oil palm, producing some 5 tons ffb per acre (12 tons ffb per ha) per year with an oil to bunch ratio of 20 to 22% might be worthwhile.

### West Malaysia

Only a few days were available in this country where the oil palm industry is already well established and documented. Field trips were limited to a Federal Land Development Authority (FELDA) settlement scheme at Kampong Suharto, Tanjong Malim, and to the Malaysian Agricultural Development Institute, (MARDI) at Serdang. At the FELDA scheme, some 5,000 acres (2,000 ha) of oil palm are in bearing, the first planting having taken place in 1964. The mill had a capacity when visited of some 14 tons ffb per hour with one automatic hydraulic press and one screw press. It will eventually have a capacity of 32 tons ffb per hour and service 13,070 acres (5,289 ha).

In contrast to the Settlement Schemes visited in Thailand and Papua New Guinea, FELDA settlers are not brought in until the palms are about to be harvested. Each family is provided with a house and a quarter acre (0.1 ha) plot and there are 8 acres (3.2 ha) of oil palm per settler, although they work collectively and are paid piecework rates. The total area of FELDA schemes under oil palms up to 1972 were 239,004 acres (96,720 ha) and the estimated total area under oil palms in the whole of West Malaysia for the same year is nearly 1 million acres (0.4 million ha).

MARDI was established in 1968 and is responsible for public sector produce research on all crops except rubber. It is also concerned with livestock, poultry and freshwater fisheries. Included in the oil palm breeding programme are crosses of P x P, both fertile parents. Some 40 acres (16 ha) of these palms have been planted since 1965 and they yield fruit of high mesocarp content with shell-less kernels. Some modification of the current milling methods would be necessary if these palms were grown commercially, but the oil to bunch ratio is expected to be very much higher than the best tenera material.

# PALM OIL FRACTIONATION - AN INTRODUCTORY NOTE

by J.A. Cornelius

In view of the wide interest of producers in extending the user outlets for palm oil in the light of an expanding production, the two following articles will be of interest. The first, by Mr. A.M. Taylor, includes a general survey of the main fractionation processes <sup>in use</sup> whilst the second article, by Mr. L. Koslowsky, describes a novel solvent fractionation method using iso-propanol which enables a separation to be achieved using less refrigeration capacity than traditional solvent methods using acetone or hexane, and without the need for filtration.

The properties and composition of the solid and liquid fractions obtained will vary considerably, depending both upon the precise conditions of processing and upon the composition of the oil before fractionation. The terms "stearin" and "olein", used in the first paper, refer to the low (liquid) and high (solid) melting point fractions respectively. These fractions are not pure tristearin and triolein but are both mixtures of glycerides of the various fatty acids found in palm oil. The user is usually more concerned to meet a slip melting point and dilatation specification rather than in knowing the actual fatty acid compositions.

The following examples have been supplied by Mr. Taylor additionally to the information in his article:

Oil	<u>Slip M.pt.</u>		<u>Dilatation, ml/kg</u>			
	<sup>0</sup> C	20 <sup>0</sup> C	25 <sup>0</sup> C	30 <sup>0</sup> C	35 <sup>0</sup> C	40 <sup>0</sup> C
Crude Palm	34.8	470	-	225	-	90
* N & B Palm	38.3	550	-	275	-	115
Crude Palm	32.2	510	-	240	-	105
* N & B Palm	38.4	580	-	285	-	100
Crude "Olein"	17.4	25	20	5	-	-
Crude "Olein"	17.4	25	25	20	-	-
Crude "Olein"	17.4	70	35	15	10	-

Average on occasions

Palm "Olein"	17	80-115	45-70	Nil		
Palm "Stearin"	46-48	1000-1100	-	750-850	-	610-720

\* Neutralised and bleached palm oil

These figures show the variation obtained in this process. The three palm "oleins" at 17.4<sup>0</sup>C slip m.pt. were samples from the same tank at different levels, showing that further fractionation was taking place, but not enough to alter the slip m.pt. It has been found that different fractionation methods can give similar dilatations but different slip m.pt. and that crude palm oil, after neutralization gives a higher slip m.pt. and a higher dilatation than originally.

As an illustration of the fatty acid compositions of the fractionated products, samples of "stearin" and "olein" derived from a normal crude Malaysian palm oil by a commercial solvent process were examined at the Tropical Products Institute by gas-liquid chromatography. They had the following composition:

	"Stearin"	"Olein"
Saturated acids		
Lauric	trace	trace
Myristic	1.8	1.2
Palmitic	74.8	40.4
Stearic	4.7	3.5
Unsaturated acids		
Oleic	16.8	44.6
Linoleic	1.9	10.4

The "olein" fraction was claimed to represent some 82% of the whole and to have a melting point of 22<sup>o</sup> to 24<sup>o</sup> C and the "stearin" fraction had a melting point of 56<sup>o</sup> C.

## PALM OIL CRYSTALLISATION AND FRACTIONATION

by A.M. Taylor, Van den Berghs and Jurgens Ltd., Greenock, Renfrewshire, Scotland.

Palm oil has increased in importance in recent years due to a world shortage of edible oils and fats and the need to replace the higher priced oils for economic considerations. Because of its composition,

Approximately 10% Tri-sat	glycerides
50% Mono	Unsat "
30% Di-	Unsat "
10% Tri-	Unsat "

palm oil has a soft texture and long plastic range making it ideal for various purposes. Once the difficulties of refining, colour removal and a tendency to lack stability are overcome, the oil is useful as a dough fat in biscuit manufacture, in margarine and shortening, and with fractionation, as a cooking and frying oil. The high cost of liquid oils has made fractionation attractive and the ease with which palm oil can be fractionated makes it worthy of serious consideration.

In the crude state, palm oil separates on slow cooling into stearin and olein. The stearin crystallises on the sides, projections and base of the tank leaving the olein at top and middle. It conforms to the age-old practice of dangling strings into a cooling solution to enforce crystallation to take place on these strings and permit easy removal of these crystals from the mother liquid. Even an oil which has been stored at 40<sup>o</sup> - 50<sup>o</sup> C tends to separate in the liquid phase, giving a higher stearin content at the base. This is important from a shipping point of view, in that oil stored for some time at this temperature and shipped in two parts may show slightly different characteristics, the top portion being softer with a lower m.pt.

Fractionation, or crystallisation is a well known method of separating two or more components in a mixture. The apparatus or equipment used may be simple or sophisticated, depending on the importance of the separated materials, their cost and the ease or otherwise of separation.

When palm oil is cooled, crystals form and if the cooling is continued the oil becomes solid. If when cooling, the crystals are examined under the microscope various forms will be seen. The main type shows as a black dot or nucleus with needles radiating outwards. As cooling continues, some of the crystals grow while others collect into groups. Then a mass of crystals appear and the whole sets solid. This demonstrates the necessity for controlled cooling conditions.

In any crystallisation, the aim is to produce a small number of nuclei round which the crystal formation grows larger in size as cooling continues. If a vast number of nuclei are formed then filtration may be difficult due to the mass of small crystals. On the other hand if the crystals group together in clumps, then the liquid phase will be occluded, the result being poor separation and yield.

To enable growth to take place, the cooling rate must be commensurate with the growth rate and mobility of nuclei, which means that viscosity plays an important part. This property is utilised in some methods. Heat transfer is important, stirring therefore being beneficial to keep the contents of the vessel uniform. The stirring should be such that the temperature drop is evenly distributed through the mass but not so much as to destroy the possibility of crystal growth.

The crystallisation of palm oil demonstrates these properties very well and the methods in use today utilise these properties to the full.

Methods:- There are four main methods of fractionating palm oil commercially.

1. Crystallisation of the crude oil by cooling and separating the fractions.
2. Dry fractionation of the neutralised and bleached oil.
3. Solvent fractionation.
4. Crystallisation followed by separation in aqueous detergent.

#### 1. Crystallisation of Crude Oil

This may be carried out quite simply by allowing the crude oil to cool naturally until separation takes place. The time taken for good separation will depend on the initial temperature of the oil, the ambient temperature and whether the tanks are lagged or not. Separation may occur in less than a week or up to a month or more depending upon the conditions and the characteristics of the olein required. The slower the rate of cooling, the longer will be the time required, the greater the crystal growth and thus better separation, yield and quality of olein produced. In this way palm oil with a starting iodine value (I.V.) of 53 can yield an olein of I.V. 58 and with a slip m.pt. of  $20^{\circ}\text{C}$ . As the yield may be in the region of 50%, the resultant stearin is fairly soft.

Separation may be obtained more quickly through a plate and frame filter press, giving a higher quality olein and a harder stearin. This process is slow with the need for constant press cleaning and is conducive to labour problems.

Some experimental work has been carried out using a centrifuge for the separation of the olein from the stearin, but further work is necessary on this method. In addition, the increased capital and maintenance costs may make it less attractive than alternative methods.

These methods tend to give a low yield of olein and a soft stearin and are generally only suitable when time and labour are available and the demand for olein is small.

It has been suggested that slight treatment of the crude oil i.e. removal of the phosphatides or mucilage and/or a light earth treatment make separation easier but I have not found this to be the case.

## 2. Dry Fractionation of the Neutralised and Bleached Oil

When a neutralised and bleached (N & B) palm oil is cooled under controlled conditions it crystallises out more quickly than crude oil and separation can be achieved in hours rather than days or weeks.

The oil is heated to  $70^{\circ}$  -  $80^{\circ}$  C so that all crystals are in solution and the batch cooled slowly but steadily with stirring. This is to ensure uniformity of temperature and viscosity. When the temperature drops to  $30^{\circ}$  C, crystallisation starts to take place and cooling is stopped a few degrees below this and the mass allowed to stabilise for a short time. Separation may again be by filter press or by centrifugal means. A better method is to use a drum filter which handles the products in an efficient manner. This method is quicker and more efficient giving a yield of olein of approximately 75% and a harder stearin.

## 3. Solvent Fractionation

The use of solvents such as hexane, acetone etc reduces the viscosity of the oil and allows greater mobility of the crystals, thus aiding the separation. Crude oil, after either the removal of phosphatides and/or a light bleach, is dissolved in the solvent, passed to crystallisers and then the stearin filtered off. Several factors, such as economics and the characteristics of the required products, determine whether more than one crystallisation is necessary. The yield from this process when a second crystallisation of the fractions is carried out can be approximately 10% hard stearin, 30% mid fraction and 60% olein; the olein having an iodine value of over 60. These figures must be treated with caution because of the variability of palm oil.

Solvent extraction gives excellent yields but the capital outlay is high and there is the operating cost and safety factor to be borne in mind. An article by Ernesto & Mario Bernardini in the November 1969 issue of Oil Palm News (No. 8) covers this subject in greater depth.

## 4. Crystallisation followed by separation in Aqueous Detergent

Crude palm oil, degummed and given a light bleach is cooled from above  $60^{\circ}$  C to just below  $30^{\circ}$  C with stirring over a period of 3-4 hours. At the end of this time aqueous detergent is added and the stearin crystals, which are wetted by the detergent, remain in the aqueous phase. The supernatant olein is skimmed off after settlement has taken place. The aqueous phase, which is left, is heated till the stearin melts and floats on the top. After settling, the aqueous layer is run off. The stearin which is left is run off to storage and the tank is then available for the next batch. Once again the olein may be recrystallised at a lower temperature (about  $20^{\circ}$  C) and treated with detergent solution when separation takes place as before.

The method, though relatively simple is high in cost due to the need for stainless steel equipment to resist corrosion. In addition, centrifuges are used to speed up the process and this increases the capital, maintenance and running costs.

The four methods described above are the ones generally in use today. Variations are possible and may be used to fit the particular circumstances. All yield and composition figures must always be treated with reserve due to the wide variation of the characteristics of palm oil.

There is an extensive range of literature on the subject of crystallisation and fractionation but the topic is not by any means exhausted. The size and form of the crystals vary with temperature and rate of cooling and this has an important bearing on the separation of the fractions and the nature of the material obtained.

Further work is necessary on all aspects on the subject.

Traces of moisture have a definite effect on the crystallisation. Neutralised and bleached oil which has been specially dried has given better crystal formation than that containing traces of moisture; and settlement is better. More work is required to determine whether water has a qualitative or quantitative effect on crystallisation and yield. Phosphatides and other impurities may affect the form of crystallisation and yield but further information is needed here also. Seeding of the cooled or supercooled oil may yield differing products and this is another subject for study.

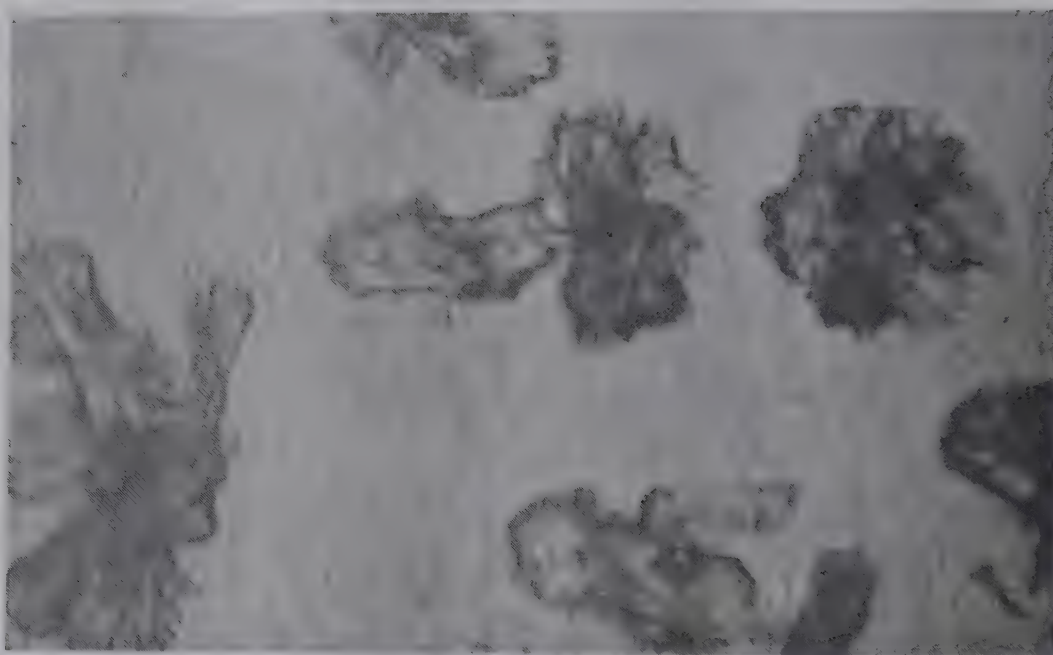
The photographs show some of the crystal formations during the cooling of crude oil and N. & B. Palm Oil.

1. This formation has only been found in crude oil and in acid oil. Note too the few scattered small crystals.
2. With faster cooling these forms have been obtained. Small crystals are showing up due to cooling on slide.
3. Mass of small crystal nucleii with rapid cooling.
4. Crystal nucleii showing growth of crystal and also conglomeration of these growths.
5. As (4) but with N. & B. Oil.
6. Crystal from N. & B. Oil pressed out with cover glass. Note break up of crystals and floral pattern.

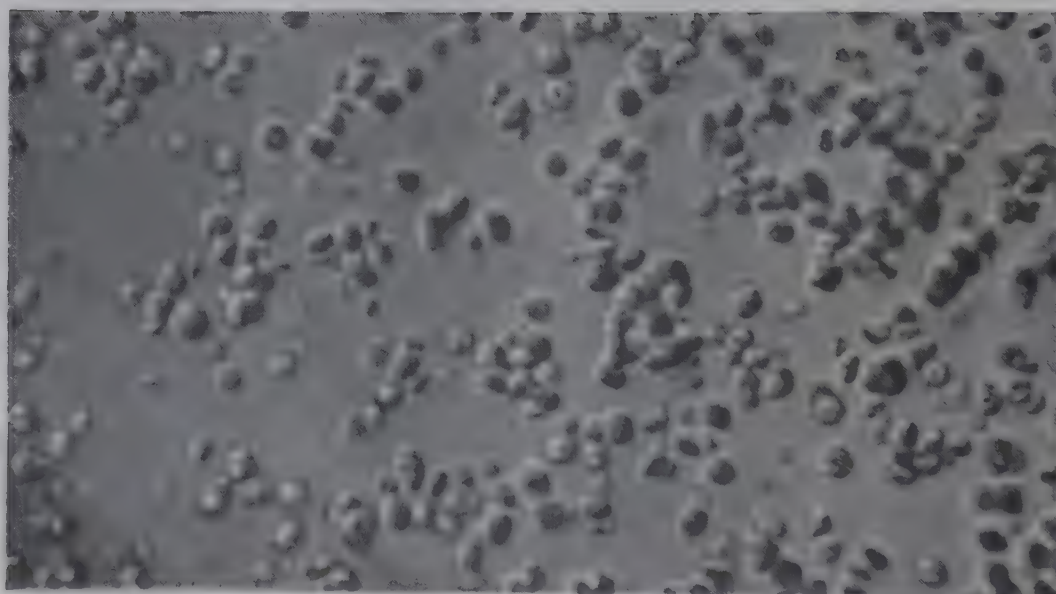
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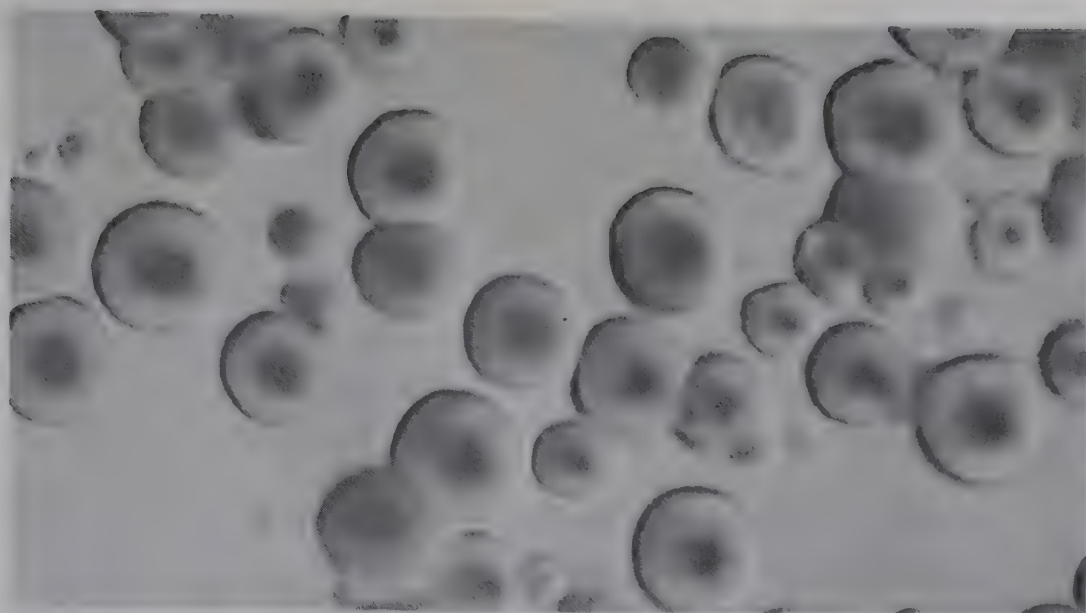
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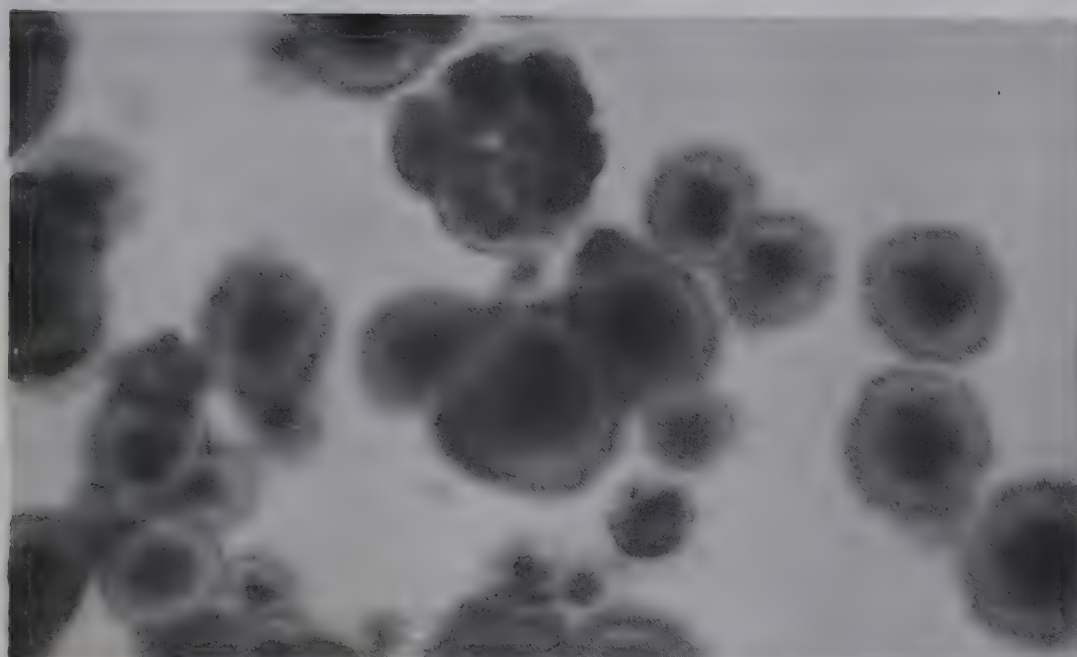
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# SALAD OIL AND EDIBLE FATS FROM PALM OIL BY A NEW FRACTIONAL CRYSTALLIZATION METHOD IN ISO-PROPYL ALCOHOL\*

by L. Koslowsky

## Summary

The H.L.S. method for fractional crystallization of palm oil is a completely new and revolutionary method that eliminates the use of filters or centrifuges present in all existing methods, and used a relatively cheap solvent containing a common natural food additive permitted all over the world, and with extremely small losses.

The problem of very special conditions of crystal growth during the crystallization necessary in the other methods, is completely eliminated. The crystallization temperature needed in double stage fractionization is 10-15°C and the equipment is fully automated, requiring only one worker per shift for supervision.

By this method it is possible to obtain liquid fractions with good chilled stability: 25°C for single stage and 15°C for double stage fractionization. The solid fractions have relatively high melting points: 46°C for first stage; 34°C for second stage and 42°C for the two hard fats collected together.

The new method provides liquid fraction yields namely 85% for single stage and 74% for double stage fractional crystallization.

## Introduction

At the request of one of our best customers, we started about two years ago to carry out in our laboratories research work in order to solve the difficult problems of fractional crystallization of palm oil.

We realised the considerable economic importance of palm oil in the world; that its production is increasing; and that it is actually the cheapest vegetable oil raw material on the market. (1)

We understand too that all the existing processes are clumsy, and the biggest obstacle in an adequate separation of fractions is the filtration or centrifugal separation of the solid oily/sticky crystals present in the cooled oil or solvent. (2)

Our aim was to find a suitable simple decantation method, which would allow the separation of the solid fraction crystals without filtration or centrifugation. At first glance, the idea seemed unusual, but after a comprehensive study we concluded that it would be possible to reach this aim if we could find the correct low density solvent, partially soluble in the palm oil, yet soluble enough to be included in the crystals (like water is in inorganic compounds as water of crystallization) in order to reduce the density of the crystals and allow them to float on the surface of the oil together with the solvent, perhaps with the help of certain natural additives at the level permitted by law and considered as food additives.

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\* A French version appeared in Oléagineux, 1972, 27, (11) 557-560.

## Laboratory Experiments

Our objective was to develop in the laboratory a new technique for separating the components of palm oil. We started our investigation to find a solvent best suited to our particular needs, namely, a cheap and easily obtainable solvent with a low density, partially soluble in oil and, with the addition of a certain cheap natural additive, which would allow us to carry out the fractional crystallization of palm oil.

We tried a whole range of polar and non-polar solvents, and we found that iso-propyl alcohol (I.P.A.) was the most suitable from every aspect.

During the course of our experiments the I.P.A. was used with the addition of a natural additive which we shall abbreviate and name in this report as - N.A. - and refined palm oil from Singapore was used as the raw material.

The solubility of palm oil in I.P.A. containing N.A. is very limited and depends on the working temperature. In the ratio of 1 part palm oil to 1 part I.P.A., the palm oil is completely soluble only at a relatively high temperature. On cooling, the I.P.A. tends to separate partially. Below 35°C the solid fat fraction starts to crystallize and gives a suspension of crystals in the separated I.P.A. The density of the suspension is lower than the density of the liquid phase. As a result of this factor, a rapid separation into two layers occurs. With fractional crystallization at 15°C for example, the upper layer contains about 17% solid fat and 83% I.P.A. The lower layer contains about 84% oil and 16% I.P.A. Due to the I.P.A. content of the liquid phase, its viscosity is decreased and the separation of the layers is effective and sharp. It was sufficient to separate the two layers by decantation in order to obtain a liquid phase - after removal of I.P.A. by distillation - with a good chilled-test stability (15°C) and a solids fraction with a relatively high melting point (42°C).

With a classical solvent (eg fractional crystallization with acetone or hexane, followed by filtration) in order to obtain the same results we were obliged to work in the ratio of 1 part palm oil to 6.6 parts of the solvent.

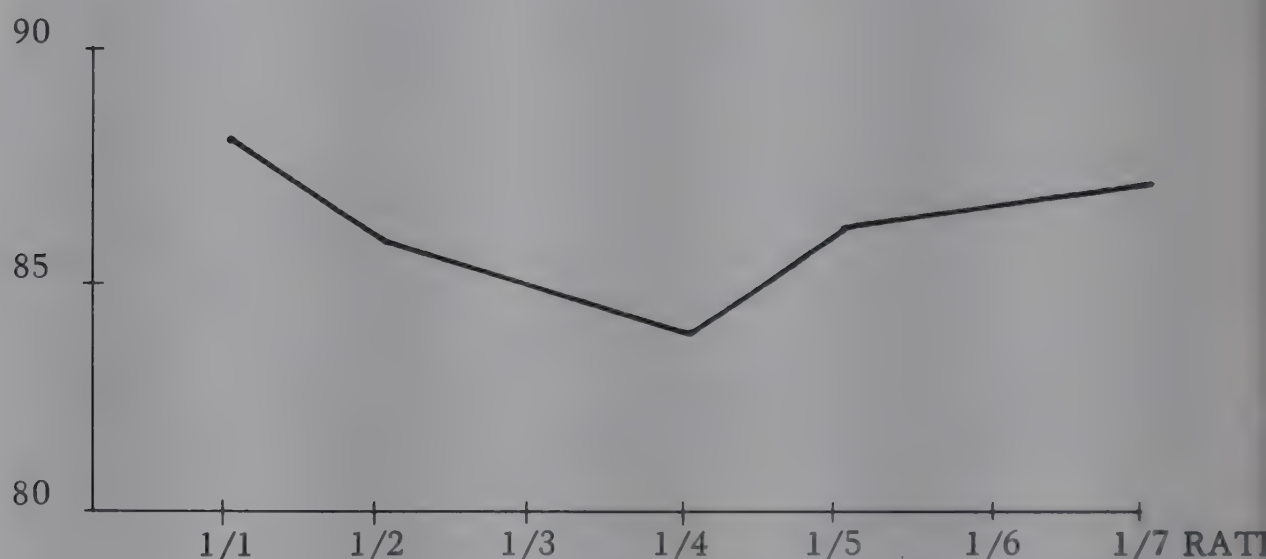
Working with the same ratio of 1 part palm oil to 1 part I.P.A. containing the N.A. but at a higher crystallization temperature (about 20°C) we succeeded in separating over 85% liquid oil with a chilled-test stability of 20-22°C, and 15% solids fraction with a melting point of 48-50°C. As a cooling agent, we used cold water.

As we mentioned above, the solubility of palm oil in I.P.A. is very limited. In order to determine the optimum ratio of oil/solvent, we carried out numerous experiments, working with the same conditions of temperature, mixing and crystallization time, but varying only the ratio between palm oil and I.P.A.

We have summarised the results of our experiments in the graph shown below, varying the ratio of palm oil/solvent from 1 : 1 to 1 : 7.

VARIATION OF LIQUID OIL YIELD AS A FUNCTION  
OF OIL TO ISO-PROPYL ALCOHOL RATIO

% OIL  
(Stability:  
20°C)



According to our experiments the best results were obtained when working with the ratio of 1 part palm oil to 1 part I.P.A. containing N.A. The yield decreases when the ratio of the solvent increases to 1 : 4. From this point the yield begins to increase again as the ratio increases. We may explain this anomaly by the variation in solubility of the fractions in the I.P.A. At a ratio of 1 : 4 and above 45°C the palm oil is completely soluble in I.P.A. Upon cooling, a separation into two layers occurs. The I.P.A. layer is very rich in the fraction with the higher melting point components, while the oil layer contains almost exclusively the fraction with the lower melting point components. Thus crystallization occurs in the I.P.A. layer, when the concentration of the solids will also be higher. By increasing the solvent ratio, the oil layer decreases in quantity because more of the liquid fraction will be dissolved in the I.P.A., and after crystallization the oil content of the solids will also be higher. The liquid phase layer decreases gradually and almost disappears completely at the ratio 1 : 4. From this composition the I.P.A. begins to behave like other solvents, and the fractionization will be better when the I.P.A. ratio in the solution is increased, but in this case it is necessary to separate the crystals through filtration.

Consequently it is more practical to separate the liquid oil directly from palm oil, using a low ratio of solvent and thereby be in the first part of the graph's curve where it is possible to separate the two layers by decantation, rather than separate the fractions by filtration (namely, to filter the crystals using a large amount of solvent in order to effect a good fractionation and to be in the second part of the graph's curve).

We also succeeded in fractionating crude palm oil with an F.F.A. content of 4.9% after degumming, by the same method. The resulting liquid oil with a good chilled-test stability had an F.F.A. content of 1.1%. The remaining F.F.A. was accumulated in the solids fraction.

With our fractionating method we also succeeded in separating in one single stage the solids fraction from partially hydrogenated soya oil, and obtained a liquid phase with melting point of  $-3^{\circ}\text{C}$ .

Similarly, we also succeeded with our method and with the assistance of additional crystallization starters, such as crystal nuclei, to winterize cotton oil and to dewax rice bran oil.

#### Laboratory Scale Continuous Pilot Plant

Our laboratory experiments were carried out on batchwise scales. In order to attempt to pass from a batchwise to a continuous process we built and assembled a complete miniature (1 kg/hour) continuous palm oil fractionating pilot plant, but without the phase of solvent recovery which we considered a known classical process.

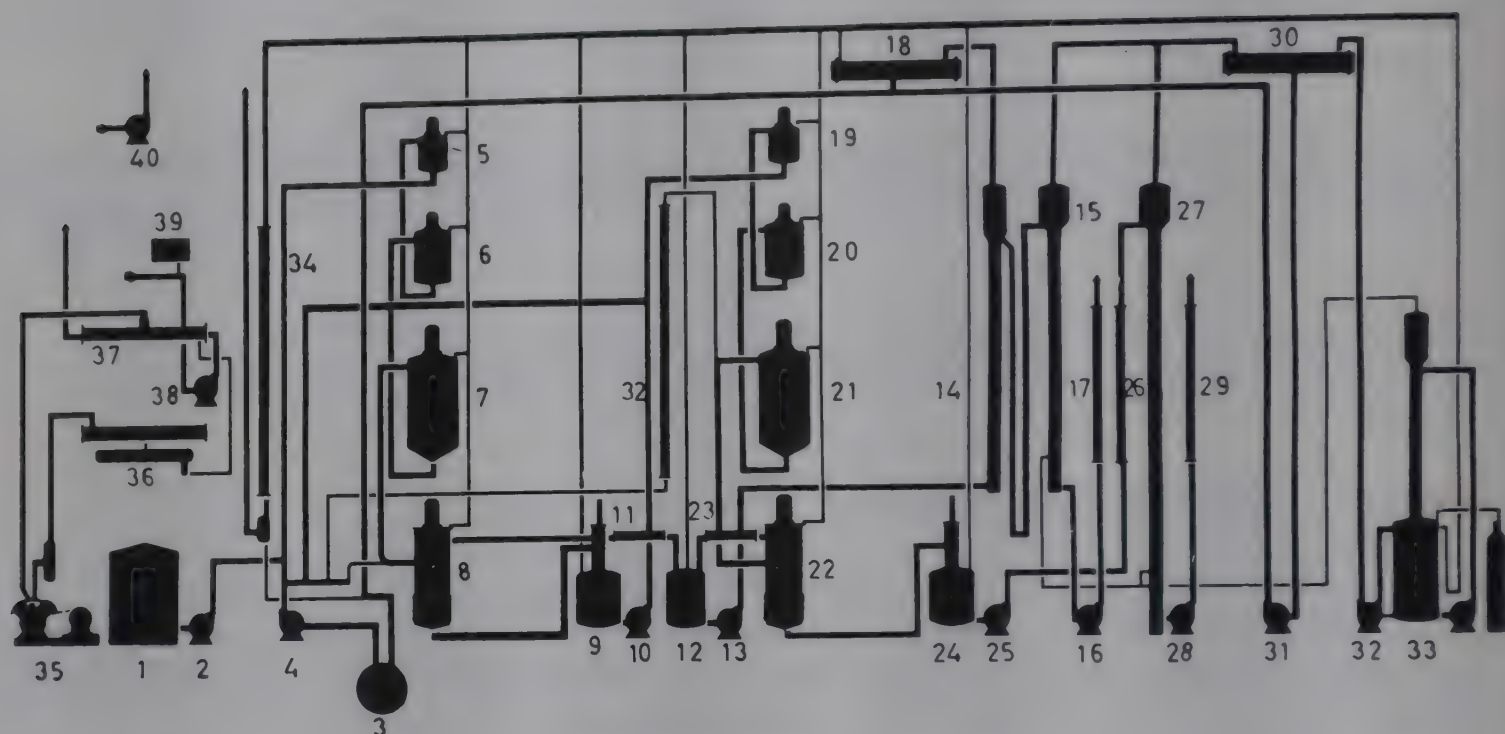
After experiencing some difficulties in the beginning, especially in the decantation of the solid fat crystals, we ultimately succeeded in providing our decanter with adequate dimensions to run with our small pilot plant, feeding it continuously with palm oil and I.P.A. with N.A. at a ratio of 1 : 1, and to collect separately the crystals as a suspension in I.P.A. on one side, and the liquid oil with a content of about 20% I.P.A. on the other side. We varied the temperature of crystallization from  $+10$  to  $+30^{\circ}\text{C}$ . For this purpose, we used a cooling device with thermostat and recirculating pump that gave us the required constant temperature from  $-30^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  within  $\pm 0.2^{\circ}\text{C}$ .

We are proceeding to two stages of fractional crystallization. The first stage at  $+30^{\circ}\text{C}$  and the second stage at  $+15^{\circ}\text{C}$ . The liquid oil obtained has a cloud point of  $5-7^{\circ}\text{C}$ , and the solid fat has a melting point of  $46-47^{\circ}\text{C}$  from the first stage, and  $34-35^{\circ}\text{C}$  from the second stage.

#### Industrial Scale Continuous Prototype Plant

On the basis of laboratory batchwise and continuous fractional crystallization results, our Company started to design an industrial scale two-stage fractional crystallization plant with a capacity of about 12 tons of palm oil per day.

We show below the flowsheet of our plant.



The palm oil is pumped from the tank (1) by means of pump (2) and through the flowmeter in mixer-heater (5) of the first stage fractional crystallization, where it is mixed with the I.P.A. containing N.A., pumped from tank (3) by pump (4). From heater (5) the oil-I.P.A. solution is sent to cooler (6) and then overflowed to crystallizer (7), and finally to the decanter (8) where the crystal suspension in I.P.A. is separated from the liquid phase and sent through heater (11) buffer tank (12) and pump (13) to evaporator (14).

The I.P.A. is evaporated together with the N.A. and condensed in the condenser (18) and sent back to the storage tank (3). The oil with traces of I.P.A. is directed through stripper (15) and by sump pump (16) to cooler (17). Thereafter it proceeds to the storage tank for solid fat.

The liquid fraction from the decanter (8) is sent through buffer tank (9) and pump (10) to heater-mixer (19) of the second stage fractional crystallization, where it is mixed with controlled amount of I.P.A. containing N.A. and coming from pump (4). From heater (19)

the oil-I.P.A. solution is sent to cooler (20) and overflowed to crystallizer (21); and finally to the decanter (22), where the crystal suspension in I.P.A. is separated from the liquid phase and sent through heater (23); buffer tank (12); pump (13); evaporator (14); stripper (15); pump (16); and cooler (17) and then to solids fraction storage tank.

The liquid phase from the decanter (22) is sent through buffer tank (24); pump (25); heater (26); stripper (27); pump (28); cooler (29); and then to the storage tank of liquid oil. The evaporated I.P.A. from stripper (15) and (27) respectively is condensed in the condenser (30), and sent to the storage tank (3) through the pump (31). It is possible to wash the decanter (8) and (22) with cold I.P.A. cooled via cooler (32).

The strippers (15) and (27) and condenser (30), work under vacuum created by vacuum pump (32). All the vapours pass through the deflagration system (33).

The whole plant is connected to the vent which is cooled by cooler (34), and the eventual condensed I.P.A. is returned to the storage tank (3).

The cooling system consists of an ammonia compressor (35), condenser (36) and evaporator (37). The brine, after cooling, is recirculated in the plant by pump (38) and buffer tank (39). The cooling water is provided by pump (40).

Our industrial scale continuous pilot plant commenced to operate about one month ago. After minor modifications we continued to run it non-stop in three shifts and at present it continues to operate and improves in performance each day.

The I.P.A. and N.A. losses are extremely low, seldom exceeding 0.1%-0.2%.

We are continuing our research in order to develop further our method, by close laboratory study of the fraction composition (with gas-chromatograph), and crystals structure and growth during the crystallization process in iso-propyl alcohol (with photo-microscopy).

## References

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2. Loders and Nucoline Ltd., Fractionating Plant for Specialised Edible Oils and Fats.
3. R.O. Fenge, Production of Speciality Edible Fats, J.Amer. Oil Chemists Soc. 37, 527-532 (1960).
4. Oil Palm News, No. 8 November 1969.

# OIL PALM MARKET SURVEY

## A REPORT BY THE COMMONWEALTH SECRETARIAT

Received 21st March, 1973

Preliminary figures indicate an expansion in world commercial production of palm oil in 1972 to 1.38 million tons, a rise of 0.16 million tons, or 13 per cent, over the 1971 total of 1.22 million tons. The actual increase in production last year was therefore rather less than had been expected at the beginning of 1972, when a total world output of as much as 1.5 million tons had been considered possible. The failure of world production to reach this figure was probably mainly due to somewhat smaller increases in output in West Malaysia and Indonesia than had been expected, and the further reductions in production in both Nigeria and Zaire. On the other hand output continued to rise both in East Malaysia and in the Ivory Coast. In contrast to palm oil, world production of palm kernels seems to have fallen slightly in total last year, since a notable increase in Malaysia was more than offset by declines in Nigeria, Zaire, Sierra Leone and Dahomey.

TABLE 1: Commercial production of palm kernel and palm oils

(Thousand tons)

	1968		1969		1970		1971		1972 <sup>c</sup>	
	oil equi- valent <sup>a</sup>	(kernels)	oil equi- valent <sup>a</sup>	(kernels)	oil equi- valent <sup>a</sup>	(kernels)	oil equi- valent <sup>a</sup>	(kernels)	oil equi- valent <sup>a</sup>	(kernel)
<u>Palm kernels</u>										
Nigeria	89	(190)	89	(190)	137	(291)	142	(302)	132	(280)
Sierra Leone	25	(54)	24	(52)	27	(57)	24	(51)	22	(46)
East Malaysia (Sabah)	1	(3)	2	(4)	2	(5)	3	(7)	6	(13)
West Malaysia	28	(59)	34	(73)	40	(86)	55	(117)	63	(135)
Angola	7	(15)	7	(15)	7	(14)	6	(13)	7	(14)
Cameroun	11	(23)	8	(17)	12	(25)	10	(21)	10	(22)
Dahomey	26	(55)	28	(60)	28	(59)	31	(65)	26	(55)
Indonesia	19	(40)	19	(41)	23	(48)	26	(55)	27	(57)
Ivory Coast	5	(10)	6	(12)	9	(20)	11	(23)	13	(27)
Mexico	7	(15)	13	(27)	13	(28)	13	(28)	13	(28)
Togo	6	(13)	9	(19)	9	(19)	9	(19)	9	(20)
Zaire Rep. <sup>b</sup>	59	(125)	52	(110)	61	(130)	57	(122)	52	(110)
Other	30	(65)	38	(81)	38	(80)	36	(76)	37	(80)
Total	313	(667)	329	(701)	405	(862)	423	(899)	417	(867)
<u>Palm oil</u>										
Nigeria	4		25		25		31		20	
East Malaysia (Sabah)	18		25		28		36		70	
West Malaysia	261		321		396		542		649	
Angola	12		11		11		12		12	
Cameroun	21		16		22		25		25	
Dahomey	10		12		14		14		9	
Indonesia	185		186		213		245		259	
Ivory Coast	15		19		42		54		86	
Zaire Rep. <sup>b</sup>	220		205		207		194		180	
Others	47		61		58		67		70	
Total	793		881		1,016		1,220		1,380	

<sup>a</sup> Converted at 47 per cent oil content. <sup>b</sup> Estimates. <sup>c</sup> Provisional.

The smaller rate of growth in world palm oil production last year as compared with 1971 is reflected by the latest export statistics of the leading producing countries, which show an expansion in 1972 of 16 per cent in total shipments, contrasting with a growth in 1971 of about 30 per cent. Thus palm oil exports from these countries in 1972 are estimated at about 1,080,000 tons compared with 933,000 tons in the preceding year, and 719,000 tons in 1970. West Malaysian exports rose by only 89,000 tons, as against 158,000 tons in 1971, to total 612,000 tons, and although exports by Indonesia and the Ivory Coast are estimated to have increased to 240,000 tons and 50,000 tons respectively, Nigerian exports dwindled to negligible proportions, while overseas sales by Zaire fell by 22 per cent to only 35,000 tons. On the import side the smaller growth in world palm oil trade in 1972 was in fact accompanied by a fall in United Kingdom palm oil imports from 219,000 tons in 1971 to 205,000 tons, while palm oil purchases by the original Six European Community countries in the first ten to eleven months of last year rose by only 6 per cent to 371,000 tons. On the other hand the United States bought a record 194,000 tons of palm oil in 1972, nearly double the quantity taken in the previous year.

The near stagnation in world production of palm kernels last year is illustrated by the latest trade statistics, which showed a virtually unchanged level of exports during the greater part of 1972. A decline in exports of kernels as such, mainly from Nigeria, West Malaysia and Sierra Leone, was approximately balanced by a 30,000 ton rise in exports of palm kernel oil, West Malaysia shipping a record 48,000 tons, easily offsetting the reductions in oil exports by Zaire and Dahomey. Among the leading importing countries the United Kingdom bought a good deal more palm kernel oil in 1972, both from Nigeria and Zaire, its total of kernel and oil purchases amounting to 72,000 tons oil equivalent. The original Six European Community countries, however, reduced their combined imports of kernels and oil in the first ten to eleven months of last year by 15 per cent to 176,000 tons, oil equivalent. United States palm kernel oil imports rose slightly in 1972 to 44,000 tons.

The last few months have witnessed notable advances in world prices of palm oil, palm kernels and palm kernel oil. Strong demand, the smaller than expected increase in world production last year, a well sold forward position, and the world shortage of fish oil have all given strength to the palm oil market, as did dollar devaluation, so that in mid-March Malaysian palm oil was quoted at no less than £115.00 per ton, cif United Kingdom ports. Although the extent of the increase in world palm oil output this year is uncertain, representatives of the leading palm oil exporters indicated at the meeting of the FAO Inter-governmental Group on Oilseeds, Oils and Fats in Rome last February that they expected the world palm oil market to remain strong in the next six months.

TABLE 2: Mid-month prices of palm oil, palm kernels and palm kernel oil

(£ per ton, nearest forward shipment, cif UK ports, excluding duties)

	1971 Average	1972 Average	1972			1973		
			Oct.	Nov.	Dec.	Jan.	Feb.	March
Palm oil, Malaysian 5%	110.08	88.08	95.00	94.00	92.00	90.00	115.00	115.00
Palm kernel, Nigeria	61.04	45.64	52.00	53.50	NA	59.75	78.00	82.00
Palm kernel oil, West African	140.67	NA	NA	NA	101.00	105.00	NA	NA

NA = NOT AVAILABLE

Some shortage of copra and coconut oil on the world market late last year and early this year resulted in rising prices for lauric items, these receiving considerable additional stimulus from the devaluation of the dollar in February. By mid-March the price of palm kernels had reached £82.00 per ton, 58 per cent greater than six months earlier. Palm kernel oil has not been regularly quoted in recent months, but current values must be appreciably above the January price of £105.00 per ton. The price outlook for laurics does not appear to be so clear as for palm oil, the more so since the devaluation of the dollar appears to have been followed by a greater reaction in copra and coconut oil values on world markets than may be justified by the present supply situation. Nevertheless the possibility of a moderate fall in world copra output this year, together with the likelihood of only a modest rise in world palm kernel supplies, suggests that lauric markets may well display a fairly firm tone in the next few months, even were some re-action from the high March values to take place.

## THE EFFECTS OF PHOSPHATED FERTILIZER ON THE OIL PALM IN BRAZIL

Martin, G. and Prioux, G., (Dept. Oil Palm, IRHO, 8 Sq. Petrarque, Paris 16e, France.) Oléagineux, 1972, 27 (7), 351-354.  
(English and Spanish summaries, 14 lines)

A factorial fertilizer experiment in the chemically poor yellow latosols of the Belem region has shown the essential role of phosphorus in the growth and mineral nutrition of the oil palm. Phosphorus increases the circumference at the root bulb by 19-26 per cent and the leaf content by 18-26 per cent.

Moreover, the application of triple superphosphate increases the nitrogen and magnesium levels in the leaves, dispensing with the systematic use of urea and magnesium sulphate during this period.

The analysis of the growth observation and the results of foliar diagnosis leads to the conclusion that phosphorus should be the pivot of fertilizer formulae and that it is only necessary to apply extra nitrogen the first year of planting and potassium chloride later particularly when leaf levels fall below 0.9 per cent.

Colombia

ANALYSIS OF THE PROBLEM OF SUBSTITUTING A MORE PRODUCTIVE VARIETY IN A CROP UNDER DEVELOPMENT  
Flechas, G.H., Revista del Instituto de Investigaciones Tecnológicas, Bogota, Colombia, 1972, 14 (78), 8-25.  
(In Spanish)

The oil palm is taken as an example of a crop with a large number of variables having an influence on its profitability. A method is given for the calculation of cost, with a list of the variables. The strategy for the determination of the plan of substitution of a more productive variety is described, with a new list of variables and relationships, and the results of a hypothetical application are given.

Malaysia

## FACTORS RESPONSIBLE FOR THE DEVELOPMENT OF PEROXIDES DURING PRODUCTION AND HANDLING OF PALM OIL

Bek-Nielsen, B. (United Plantations Bhd, Teluk Anson, Perak, W. Malaysia) Oléagineux, 1972, 27 (7), 379-383 and (8-9), 443-446.  
(In English, French and Spanish summaries, 36 and 37 lines)

The development of peroxides does not appear to have begun in the normal quality of fruit arriving at the mill. However, with extracted oil the risk of oxidation becomes imminent, particularly at high temperatures. Purifying at high temperatures in ordinary purifiers can cause oxidation. The presence of moisture at about 1.0 per cent in the oil appears to act as an oxidation inhibitor. It is recommended that the advantage of sparging the oil with nitrogen at the time of shipment should be further investigated together with the possibility of thermostatic control and thermograph recorders in ships carrying palm oil.



## EFFECTS OF GROWTH REGULATORS ON FRUIT ABSCISSION IN OIL PALM

Chan, K.W., Corley, R.H.V. (Oil Palm Genetics Laboratory, Layang-Layang, Johore, Malaysia) and Seth, A.K., Ann. appl. Biol., 1972, 71 (3), 243-249.

By delaying harvest of fruit bunches of the oil palm an increase in their oil content can be obtained, but this is accompanied by increased harvesting costs and lower oil quality, as the number of detached fruit increases. Treatment of ripening bunches with auxins (2, 4, 5-trichlorophenoxy propionic acid; 2, 4-dichlorophenoxyacetic acid and  $\alpha$ -naphthaleneacetic acid) gibberellic acid and ethephon (2-chloroethylphosphonic acid) retards fruit abscission and harvest can be delayed by up to 5 days without increase in the number of detached fruit. Indications are that oil yield might increase by more than 5% during this period, without change in harvesting costs or oil quality.

## EFFECTS OF NITROGEN, PHOSPHORUS, POTASSIUM AND MAGNESIUM ON GROWTH OF THE OIL PALM

Corley, R.H.V. and Mok, C.K. (Oil Palm Genetics Laboratory, Layang-Layang, Johore, Malaysia), Expl. Agric., 1972, 8, 347-353.

Potassium application appeared to increase dry matter production and yield of oil palms, primarily by increasing leaf area, while nitrogen increased both leaf area and net assimilation rate. Responses to phosphorus and magnesium were harder to interpret. Production of vegetative dry matter attained a fairly constant level at the higher rates of fertilizer application, while the ratio of bunch yield to total dry matter production was little affected by fertilizer treatments. The importance of these results for oil palm breeding, and their possible value in diagnosing fertilizer requirements, are briefly discussed.

## OBSERVATIONS ON BORON-DEFICIENT OIL PALMS - Rajaratnam, J.A., (Faculty of Agriculture, University of Malaya, Kuala Lumpur, Malaysia), Expl. Agric., 1972, 8, 330-46.

Complete nutrient + boron treatments were imposed on seedling and young oil palms growing in sand and water culture. A number of symptoms were observed on the boron-deficient palms, including the development of high endogenous auxin levels. The relation of morphological symptoms with IAA (Indole Acetic Acid) concentration is discussed. Comparisons were made of dry matter production, leaf area and leaf boron concentration.

## A REVIEW OF THE ROLE OF ACTI-DIONE FOR PLANT DISEASE CONTROL IN MALAYSIA

Yoong Si et al. (Shell Malaysia Ltd., Kuala Lumpur, Malaysia), Planter. Kuala Lumpur, 1972, 48 (558), 242-245.

Cycloheximide (Acti-dione) is an antifungal antibiotic which is finding increasing usage for the control of a wide range of fungal diseases of crop plants. It has been used not only as an abscission agent but as a rodent repellent and is comparatively safe to human beings. Results of recent trials have indicated that cycloheximide controls bunch rot (*Marasmius palmivorus*) of oil palm. Trials are now in progress to evaluate the optimum dosage rate.

## Nigeria

## MODERN SOLVENT EXTRACTION PLANT IN NIGERIA

Anon., Oil Mill Gazetteer, 1972, 77 (4), 24-25.

Extraction De Smet, Belgium announces the sale of another complete solvent extraction factory for Nigeria. The plant will be installed at Warri (Mid West State) and will process 180 tons daily of palm kernels by direct solvent extraction without pre-exPELLING, producing high grade, light coloured low FFA final crude oil and pelletized extracted meals for export.

Two identical direct solvent factories have already been supplied by De Smet, one of which has been operating on direct extraction of palm kernels at Niproc, Arondezuogo, East Central State, for about one year.



## BLEACHABILITY OF NIGERIAN PALM OIL

Nigerian Institute for Oil Palm Research, Fifth Annual Report, 1968-69, pages 92-93, (P.O. Box 1030, Benin City, Mid-West Nigeria).

A simple modified method for rapidly assessing bleachability of palm oil was developed and tentatively adopted. The method consisted of vigorously shaking a solution of 10 ml of palm oil in 10 ml of chloroform with 5 gm Fuller's Earth Fulmont 700C for two minutes and filtering the suspension through Whatman No. 541 filter paper. Bleachability was determined on 30 samples of palm oil by a standard oil bath method as well as by the chloroform method. Statistical analysis of the results showed a highly significant correlation ( $r = 0.505$ ) between the values obtained by the two methods.

However as the results are within a narrow range of colour values more oil samples which differ widely will have to be analysed before the chloroform method can be considered applicable to those samples also.

## BIO-DEGRADATION OF PALM OIL

Nigerian Institute for Oil Palm Research, Fifth Annual Report, 1968-69, page 93 (P.O. Box 1030, Benin City, Mid-West Nigeria)

It has been reported that pure cultures of *Neurospora* and *Trichoderma* did not cause deterioration of palm oil. But as biological deterioration of palm oil under West African conditions has always been considered probable, the experiment was repeated in a modified form. The modified approach was to inoculate the oil with micro-organisms that are encountered in oil stored for a long time.

A sample was taken from oil that had been in an ordinary steel drum for about one and a half years. The residue after centrifugation was used to inoculate a culture medium consisting of potato dextrose agar. Within two days different kinds of fungi and bacteria were found to grow in the medium. These were isolated and sub-cultured. Pure cultures of fungi and bacteria were then obtained by repeating the culturing process. It is planned to grow these fungi and bacteria individually in palm oil with a view to studying the changes in oil characteristics.

(See also OPN No. 4 p 26 and OPN No. 6 p 21 - Editor)

## Sierra Leone

### PALM OIL MILL TO RE-OPEN

Anon., Sierra Leone Trade Journal, 1972, 12 (2), 51.

The SLPMB palm kernel oil mill which has remained dormant for over four years is to start operating again by the end of this year.

An agreement for the re-habilitation and reconditioning of the mill by Buhler Bros of Switzerland was signed in June.

When the mill goes into operation again it is expected that over 200 Sierra Leoneans will be employed to provide palm kernel oil for local consumption. The possibilities of exporting the oil produced to neighbouring countries will be explored.

## United States of America

### USA PALM OIL ON THE RISE

Bartholemew, D.M., (Soybean Complex Specialist Merril, Lynch, Pierce, Fenner and Smith Inc., 350 N. Michigan Av., Chicago, Ill. 60604), J. Amer. Oil Chem. Soc., 1972, 49 (1), 8A-10A.

The fat and oil industry is becoming more aware of palm oil because for the first time in history it is being produced in quantities that are of significant volume in relation to fats and oils from other sources. Furthermore it is in a strong growth phase which will extend until at least 1980 and will be reaching the market in a reasonably steady supply each month of the year.

In the years ahead palm oil is expected to take first place in the palm group (coconut, palm and palm kernel oils), which at present make up only 11 per cent of world fats and oils production.

Palm oil expansion prospects are the greatest from new palm plantations and plantings particularly in SE Asia where it is expected production will reach one million tons before 1980. US imports of palm oil have risen from a total of 64.3 million pounds in 1967 to 145.8 million pounds in 1971. A history of price quotations in the US for palm oil is somewhat limited. This is understandable because it is only recently that this oil



has received broad-scale attention. It can be noted however that palm oil prices have yielded some of their premium to soybean oil in recent months. This is strongly indicative of the increased competition from newly expanded production. In other words a new era has evolved in which strength in soybean oil may not be freely translated into palm oil prices.

#### General

##### PALM OIL OUTPUT MAY RISE AGAIN

Anon., West Africa, September 29th, 1972, p 1298.

World palm oil production in 1972 may total 2.1 million metric tons, an increase of 185,000 tons above the 1971 volume, according to the US Department of Agriculture's Statistical Report. The key factors for the commodity in 1972 are given as: accelerated expansion of harvested acreage in Ivory Coast and Sabah, which will increase exportable supplies by nearly 60,000 tons; below average rainfall in West Malaysia, which may trim the 1972 increase in output to perhaps only 50,000 tons or one third of last years expansion; and some reduction in West Malaysia's stocks which could perhaps boost exportable supplies by an additional 20,000 tons. After 1972 the Department anticipates substantial consecutive annual increases in world exports due to expanding acreages (chiefly W. Malaysia, Sabah and Ivory Coast) and increasing average yields in the face of relatively small increase in domestic consumption in the major exporting countries. World exports are expected to approximate 1.1 million tons - 138,000 tons above the 1971 volume.

##### FIRST OBSERVATIONS ON THE CYTOHISTOCHEMICAL CHARACTERS OF THE RESISTANCE OF OIL PALM TO "SUDDEN WILTING"

Arnand, F. and Rabéchault, H., Oléagineux, 1972, 27 (11), 525-529.

(English and Spanish summaries, 11 and 12 lines)

Several cytohistochemical factors of the resistance of oil palm to diseases have emerged from transversal sections taken from the roots. The resistance of E. melanococca and its hybrids in comparison with E. guineensis may be due to the greater lignification and development of both the hypodermis and the external critical parenchyma and above all to the presence of undesirable tannins in the cells of the endoderm and the neighbouring cells of the phloem.

##### METHOD OF CONTROLLING THE POPULATION LEVEL OF

##### Coelaenomenodera Elaeidis

Mariau, D. and Besombes, J.P., (IRHO, B.P. 13, Bingerville, Cote-d'Ivoire), Oléagineux, 1972, 27 (8-9), 425-427.

Coelaenomenodera elaeidis and its depredations are described. This insect is endemic in many oil palm plantations, where the parasite maintains a biological equilibrium. For several reasons, this equilibrium can be upset, entailing a strong pullulation of Coelaenomenodera. This is followed by serious destruction of the foliar surface with a consequent lowering of production. It is therefore necessary to follow the population growth and the level of infestation. A technique for estimating infestation level is described. This enables one to take measures and to decide the dates at which control is necessary for maximum efficiency.



#### THE BIOLOGY OF *Coelaenomendera elaeidis*

Mariau, D. and Morin, J.P., (IRHO, B.P. 13, Bingerville, Cote-d'Ivoire), Oléagineux, 1972, 27 (10), 469-474. (English and Spanish summaries, 19 and 20 lines)

This is a study of the dynamics of the host-parasite complex when the pest is either in an endemic state or a state of pullulation. In the former case, the insect can be observed on the oil palms at all stages of its development. Since they can always find hosts, the parasites are sufficiently numerous to react quickly to any increase in the pest population. In the case of pullulation, the development cycles are very differentiated and it is only at certain periods that either the eggs, the larvae of the pupae can be found.

Two means of control of *Coelaenomendera* are envisaged: chemical control against the larvae, and biological control by the introduction of a parasite leaving a wider spectrum of activity than the local parasites, which only attack a very short period of the larval life of the pest.

#### THE CONSTRUCTION OF AN ELECTRIC GERMINATOR

Martin, G., (IRHO, Paris), Oléagineux, 1972, 27 (11), 535-536. (In French)

Seeds of the oil palm require well defined conditions of heat, humidity and aeration in order to germinate. Every industrial development of an oil palm estate must have a special facility in order to ensure seeds are in the best condition for germination. The germinator must be insulated and be capable of close temperature control and a uniform temperature throughout the apparatus.

The inside must be provided with wooden shelves to carry, according to the method of germination used, the containers or plastic bags containing the seeds. The necessary heating is obtained by warm air, circulation of warm water or electric heaters.

This note describes the construction of an electric germinator with a capacity of between 300,000 to 320,000 seeds which corresponds to the annual need of a replanting programme for a plantation of 1,000 hectares.

#### PALM OIL PROCESSING - BLEACHING

Martenenghi, G.B. (Milan University, Milan, Italy), Oléagineux, 1972, 27 (11), 553-555 (English and Spanish summaries, 16 and 18 lines)

The principal of the bleaching method used for palm oil is not the same as that normally applied to oils and fats. It does not involve the absorption of pigments on activated earth or charcoal, but the destruction of the carotenes to which the oil owes its deep orange colour. There are two ways of achieving this: by oxidation with air at a temperature preferably no higher than 110°C or by the action of heat at temperatures over 137/140°C. The latter is the only method suitable for oils to be used in food. However the use of earth can play an important part. From the second part of this study it will be seen that the ideal conditions for achieving satisfactory bleaching are: temperatures between 240 and 260°C approximately, a processing time of from 5 to 10/15 minutes and if possible a vacuum of less than 1 mm Hg, and a supplementary treatment by about 1 per cent of earth at about 100°C.

#### POSSIBILITY OF AN ASIAN OIL PALM COMMUNITY

Tropical Products Quarterly, Sept 1972, 13 (3), 339.

ECAFE recently announced that eight Asian countries had expressed interest in the possible creation of an oil palm community, following a UN report on the economic advantages of developing the oil palm industry in Asia. The UN also recommended the commissioning of a world market survey of oil palm products, with the assistance of the UNDP, to serve the interests of producing countries.



INSECTICIDE TREATMENT FOR OIL PALM PLANTATION  
Besombes, J.P. (IRHO, Paris), Oléagineux, 1972, 27 (10),  
479-481.

Whether in the nursery or after planting out, the palms are liable to attack by various insects which may be controlled with insecticidal sprays. Taking account of the stage of development of the trees, the insecticide necessary for control must be adapted to the age, vegetation stage and the extent of the surfaces to be treated. Details are given of treatments for nurseries, young and mature plantations.

#### THE MANURING OF OIL PALMS IN THE FIELD - PAST RESULTS

Green, A.H., (Agricultural Research Advisor, Unilever Plantations Group, Unilever House, London E.C.4) Oléagineux, 1972, 27 (8-9), 419-423.  
(In English, French and Spanish summaries, 27 and 28 lines)

The fertiliser requirements of the oil palm have been under investigation for more than fifty years. It was early appreciated that the palms remove large quantities of nutrients from the soil but the profitability of applying commercial fertilizers was questioned.

Although the results of early experiments in Africa were not encouraging, considerable advances have been made, particularly since the early 1940's when foliar analysis was first used as a guide to nutrient status. Accepted today as a valuable tool, leaf analysis has its limitations and remains a qualitative rather than a quantitative guide to fertilizer needs. Foliar analysis is usually a reliable guide to K deficiency and muriate of potash increases production on most soils. Responses in excess of three tons of bunches per hectare are reported. Magnesium deficiency is also common. However, leaf magnesium levels are very variable and not all responses have been in accord with expectation based on foliar composition.

OBSERVATIONS ON THE GERMINATION OF OIL PALM SEED  
Hoeppe, C. (343 Witzenhausen, Steinstrasse),  
Der Tropenlandwist, 1972, October, 73, 214-218.  
(In German)

Controlled heat treatment of oil palm seeds results in germination between 85-95 per cent and a reduction in germination period. The observations were made on (a) 50 untreated dura dumpy seeds sown directly into sand trays and kept at 26°C in a germination chamber and (b) 53 heat treated dura dumpy seeds (kept at 39°C for 80 days) then sown in the germination chamber. 25 seeds were treated with a fungicide solution (Captan) 5 weeks after a test of the heat treatment (c) 49 tenera seeds heat treated in Malaysia were sown in a germination chamber after 168 hours soaking in water. The results obtained were consistent with known data. Preliminary conclusions are: small numbers of oil palm seeds can be heat treated successfully in electrical incubators. Captan based fungicides have a phytotoxic effect on the seeds. Heat treatment stimulates the development of twins and triplets in the seeds.

EFFECT OF METHYL BROMIDE FUMIGATION ON OIL PALM SEED  
Mok Chak Kim, Proc. Int. Seed Test Ass., 1970, 35 (1),  
243-253

Phytosanitary treatment of imported palm seed is desirable.

Methyl bromide fumigation of oil palm seed as a possible alternative to a pesticide for control of pests was investigated in two experiments.

The experimental results show that dura seeds at a moisture content of 10% can be fumigated at 75°-85°F with 2 lb methyl bromide per 1,000 cubic feet for as long as eighteen hours without impairment to viability or significantly affecting germination, emergence or growth of seedlings in the sand bed.



SALAD OIL AND EDIBLE FATS FROM PALM OIL BY A NEW  
FRACTIONAL CRYSTALLIZATION METHOD IN ISO-PROPYL  
ALCOHOL

Koslowsky, L. (POB 193, Petah-Tikva, Israel), Oléagineux,  
1972, 27 (11), 557-560  
(English and Spanish summaries, 20 and 22 lines)

The HLS method for fractional crystallization of palm oil is completely new and eliminates the use of filters or centrifuges present in all existing methods and uses a relatively cheap solvent containing a common natural food additive permitted all over the world.

The problem of special conditions of crystal growth during crystallization in other methods is completely eliminated. The temperature required in double stage fractionation is 10-18°C and the equipment is fully automated requiring only one worker per shift for supervision.

The new method provides liquid fraction yields of 85 per cent for a single stage and 74 per cent for double stage fractional crystallization.

(An English version appears in this issue - Editor.)

RESEARCH ON THE CULTURE OF OIL PALM TISSUES

Rabéchault, H., Martin, J. P. and Cas, S. (70, route d'Aulnay, 93-Bondy, France) Oléagineux, 1972, 27 (11), 531-534  
(English and Spanish summaries, 15 lines)

Cultures of oil palm tissues and their organogenesis have been obtained in vitro in the course of experiments which have compared 48 basic media associated with various auxin levels. The content of major mineral elements should not be less than 1800 mg/l.

The greatest cellular proliferation is observed in the tissues surrounding the apex; the faculty decreases as the distance from this point increases.

"Physiological shocks" improve organogenesis. They consist of increasing the concentration of mineral salts, the concentration of saccharose and the light intensity.

SOME NOTES ON THE FRACTIONATION OF PALM OIL  
Tjang, T. D. and Olie, J. J. (Stork-Amsterdam,  
N.V. Amstelveen, Holland), Planter - Kuala Lumpur, 1972,  
48 (557), 201-206

Some properties of palm oil having a bearing on its fractionation are discussed. A brief description is given of three possible methods of palm oil fractionation, namely simple winterization, solvent fractionation and fractionation by separation of crystallised fat after addition of detergent solution.

Production methods should be geared to the required quality of the fractionated liquid palm oil and solid palm fat and the marketing of these end products should be carefully studied with the object of creating new markets. The various factors which need be considered in a feasibility study of palm oil fractionating plant are set out.



## TRAINING AND INFORMATION

The Bureau is prepared to advise management in the oil palm industry on the training of personnel. Details of the nationality, linguistic abilities and educational background of the candidate would be needed, together with the purpose for which training is required. Information is available about the funds which can be provided to assist in training and the Bureau can advise on how such assistance may be obtained.

The Tropical Products Institute has one of the world's best libraries of periodicals and works of reference dealing with the products of developing countries and photo-copies of articles dealing with the oil palm can be provided on request. Answers to technical queries concerning the oil palm can also be dealt with; certain agronomic or engineering inquiries might have to be referred outside the Institute, but the Secretary of the Bureau would endeavour to find the best source of information.

In general, no charge will be made for any of the services provided but, if in a specific instance any charge has to be made, the inquirer will be notified in advance before he is committed to any costs.

Inquiries should be addressed to:

The Director,  
Tropical Products Institute,  
56-62, Gray's Inn Road,  
LONDON, W.C.1.  
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# OIL PALM NEWS

**OIL PALM ADVISORY BUREAU, TROPICAL PRODUCTS INSTITUTE, LONDON.**

## EDITORIAL

This issue contains a note on the role of chlorine as an essential element in the nutrition of the oil palm following recently published work by IRHO. This is an element which, previously has not been considered in the fertilization of oil palms and the article and publication referred to will be of general interest to those concerned with the maintenance of plantations in different countries.

There is also a note of the visit to Nigeria, Ghana and Cameroon, earlier this year by a member of TPI staff, Dr. R. V. Harris, as well as a note on palm oil refining and further processing. The latter is particularly directed to the non-technical readers of Oil Palm News.

Palm oil has continued to command a fairly high price on the world market, the Public Ledger of September 9, 1971, quoting Malaysian 5% ffa cif UK/Cont. Jan/Feb. at £118/ton. Malaysia is still the leading world producer. Rehabilitation of the industry in Nigeria is taking some time to accomplish but a large proportion of the production is believed to be consumed internally, leaving little surplus for export at the present time. Indeed, it is being suggested that Nigeria may become an importer of palm oil in a few years' time unless production can be effectively stimulated. It is noted that the Nigerian Produce Marketing Board has recently increased the price paid to the producers for palm oil and palm kernels with the latter object in view but it remains to be seen whether this is going to prove effective.

The final date for the receipt of articles and comments for the 13th issue, due to appear in May 1972, is the 7 February.



## CONTENTS

	Page
Editorial ... ..	(i)
Chlorine in the Nutrition of the Oil Palm ... ..	1
Italy, Ghana, Nigeria, Cameroon and the Oil Palm Industry, February-March 1971 ... ..	4
Oil Palm Market Survey - A Report by the Commonwealth Secretariat...	11
Book Reviews ... ..	15
Recent Publications ... ..	18
Training and Information ... ..	26



# CHLORINE IN THE NUTRITION OF THE OIL PALM

By C W S Hartley

Consultant to the Oil Palm Advisory Bureau

The mechanical use of leaf analysis to determine fertiliser programmes has been much criticised in recent times. Although gross nutrient deficiencies can be detected by leaf analysis and critical levels proposed for the principal nutrients have been useful guidelines, there have been numerous instances of yield responses being obtained where leaf levels of a nutrient have been at the supposed critical level and equally of no responses to fertilisers where leaf levels have been below the critical level.

More than ten years ago Prevot and Ollagnier<sup>1</sup> showed that, for conditions obtaining in the Ivory Coast, there was no correlation between potassium leaf levels and yield where nitrogen levels were below 2.7%; and conversely there was no correlation between N levels and yield with K levels below 1.1%. More recently Ruer's work<sup>2</sup> has suggested that where climatic conditions are unfavourable the critical level of potassium may be set at a much lower figure than where conditions are favourable. Results in Malaysia suggest that other factors are at work to modify critical levels since cases have been encountered both where yield responses to potassium have occurred with no shift in the already satisfactory K level and also where potassium responses have not been forthcoming even though leaf levels of K were below the supposed critical level, and in general it has been possible to push the K levels higher on some soils than on others. All these findings indicate that both other nutrients and environmental factors may modify the leaf levels below which a response to a nutrient will be obtained, and that the interpretation of leaf analysis data in the absence of fertiliser experiments in the same area may be a hazardous business.

An unexpected and important new development in oil palm nutrition and leaf analysis which bears on this subject has now appeared from two papers describing an experiment in the valley of the Magdalena river in Columbia.\* Potassium is usually supplied either as the sulphate or as the chloride (muriate of potash), the latter being perhaps more commonly employed because it is usually cheaper. In the Colombian experiment, which included sulphate of ammonia, potassium chloride and magnesium sulphate each at three rates (0, 1 and 2 kg/palm/ann. in the case of KCl) leaf-K was approximately at the level believed to be critical (1.0% of dry matter). However, significant yield responses to one or both rates of potassium chloride application were obtained in three out of four years, while the leaf-K levels of palms in the plots receiving KCl were actually and significantly lower than in the plots not receiving potassium. Leaf analysis for chlorine during the last two of the four years showed that in the control plots leaf-Cl levels were unusually low and that application of potassium chloride had more than doubled the levels. Moreover, when the leaf-Cl and leaf-K percentages of the 27 plots of the experiment were respectively plotted against the bunch yields of these plots it was seen that there was a marked positive correlation with yield in the case of leaf-Cl but no correlation in the case of leaf-K. It was concluded on this evidence that the yield responses should be ascribed to chlorine and not to potassium.

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\*OLLAGNIER, M and OCHS, R. Le Chlore, nouvel élément essentiel dans la nutrition du palmier à huile. *Oléagineux*, 26, 1, 1-15, Jan 1971. OLLAGNIER, M. and OCHS, R. La nutrition en Chlore du palmier à huile et du cocotier. *Oléagineux*, 26, 6, 367-72, June, 1971.

If this conclusion is justified then it will be necessary in the case of potassium manuring always to consider the chlorine status of the palms. While agreeing with the authors that the results obtained give a very strong indication of chlorine deficiency and response, one would nevertheless like to see this interpretation finally confirmed in this area by comparisons of manuring with the sulphates and chlorides of both potassium and magnesium when one might expect to obtain yield responses to the sulphates if K and Mg are needed and to the chlorides if Cl and Mg are needed (Magnesium being recorded as the principal deficiency in this area). The authors suggest (Table VIII of their first paper) that in fact only magnesium chloride is required, and they draw attention to a further interesting result of the experiment, namely that leaf-calcium levels increase with increasing KCl applications. Leaf-calcium is usually depressed by potassium sulphate application, so it is suggested that chlorine has a positive effect on calcium levels which, in turn, and owing to Ca-K antagonism, depress the potassium levels. This thesis finds some support in an experiment in the Ivory Coast where potassium chloride and potassium sulphate were compared. Leaf-K was raised to a higher level by the sulphate. Thus in any experiment comparing chloride and sulphate the possibly depressive effect of the chlorine radical on potassium uptake has to be borne in mind.

The authors of these papers have collected a fair number of leaf-chlorine analyses from various parts of the world, some from fertiliser experiments and some from plantations. In all the experiments potassium had been applied as the chloride. The values of leaf-chlorine given range from 0.1 to 0.9 per cent of dry matter which suggests that chlorine should be placed among the major rather than the trace elements. The Colombian experiment indicated that until the level reaches 0.5% there is a deficiency, but analyses from elsewhere suggest that under other conditions 0.3% may be sufficient.

It is considered that chlorine deficiency may be attributed to remoteness from the coast as much as to parent material since those areas far from the ocean or having rain-bearing winds from the interior, e.g. Belem, Brazil, show the lowest chlorine levels. The authors quote authorities to show that a sufficiency of chlorine is normally brought to coastal areas by rain. In such situations, in spite of lack of fixation and heavy leaching, the amount of chlorine brought by rain is sufficient for the requirements of crops.

It is worth noting that in the large number of fertiliser experiments carried out in Nigeria and not mentioned in these papers, potassium sulphate was used in all but a few cases and K responses were nearly always obtained. The chloride was employed however in one of the earliest factorial fertiliser experiments laid down in West Africa. The NPKCa experiment at Umudike 3, 4 allowed for heavy doses of all nutrients, but the applications were not repeated. The results were remarkable in showing an early depression of yield from calcium application and for a response to potassium chloride of more than 100 per cent which lasted for more than twelve years. In view of the common fixation of potassium and the lack of fixation of chlorine already referred to it seems unlikely that chlorine played any part in this result.

Simultaneous responses to potassium and chlorine are suggested by the results of certain Unilever experiments in West Africa (Cameroon) and Congo which are described in the first paper; although the results are presented as evidence of chlorine deficiency and

response, there are no decreases in leaf-K with potassium chloride application as in the Colombian experiment and in all cases small increases of leaf-K are shown of which one is highly significant.

There remains the question of possible chlorine toxicity with continuous potassium chloride manuring. The authors do not present any strong evidence of this; nevertheless, owing to the depressive effect of chlorine on potassium levels in the Colombian experiment they recommend the use of the sulphate where leaf-Cl levels are high. They also draw attention to the possibility of an excess of chlorine being responsible for a reduction in percentage oil to bunch, a phenomenon which has been noted in a Malaysian experiment following potassium chloride applications.

There is no doubt that this work constitutes a valuable addition to the understanding of oil palm nutrition and much more interest may now be expected in chlorine in all regions where the crop is grown.

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# ITALY, GHANA, NIGERIA, CAMEROON AND THE OIL PALM INDUSTRY, FEBRUARY-MARCH. 1971

By R. V. Harris

This note records impressions resulting from a recent visit of a member of staff of the TPI Oils, Fats, Waxes and Edible Nuts Laboratory to Italy and West Africa.

## Italy

The company Construzioni Meccaniche Bernadini s.p.a. at Pomezia specialises in equipment for the oils and fats and soap industries and has developed a process for winterisation of oils in solvent (see Oil Palm News, 1969, (8) 8-13). The company claims a 70 per cent yield of liquid fraction of 8-9°C cloud point from crude palm oil. Subsequently, it was learnt in Lagos that although one firm there uses fractionated palm oil in margarine blends, attempts to produce a fully liquid cooking oil by another fractionation process has resulted in poor and uneconomic yields. More recently, Bernadini are developing a combined interestification/winterisation process to produce a 3-4°C cloud point fraction from palm oil.

## Ghana

The country is deficient in palm oil for edible and industrial uses and Pretsea State Farm is the only oil palm estate currently operating. The area, near Takoradi is not entirely suitable climatically, since the rainfall is below optimum (58 inches in 1970). The farm occupies 10,000 acres and is currently expanding at the rate of 1000 acres annually. Seed is purchased from the Oil Palm Research Centre, Kade and extensive nurseries are run at Pretsea. Local farmers are encouraged to plant oil palm and bring their fruit to the mill for processing. Thirty-five per cent of fruit processed comes from this source. A modern mill, opened two years ago, is operated but not yet at full capacity. Palm oil production is 3,500 tons per year and all is sold locally. It was estimated that it would take ten years to meet domestic demands at the present rate of expansion. All the palm kernels are exported. The Oil Palm Research Centre at Kade produced two million seeds and seedlings last year for distribution to farmers.

## Nigeria

Two plantations were visited, the Pamol Cowan Estate at Sapele and the Western Nigeria Development Corporation Estate at Apoje near Ibadan. There was no opportunity to visit the main oil palm areas in the South East State. The Apoje estate occupies 10,000 acres and planting was proceeding at about 100 acres per year. The oil is entirely of the technical grade with over 5.0 per cent FFA (TPO), 70 per cent of which is sold locally, the remainder goes to Lever Bros. at Apapa for soap manufacture. Palm kernels are sent for crushing to the mill at Ikeja, Lagos. A new mill with a Colin press has been partly completed.

The Cowan Estate at Sapele is the only remaining Unilever oil palm plantation in Nigeria. The estate comprises 6,800 acres and the fruit is processed in a well maintained hydraulic press mill, most of the oil being of 2-3 per cent FFA (SPO grade). Palm oil and kernels are sold to the State Marketing Board.

### The Cameroon

The major palm oil producers in West Cameroon are Unilever and the Cameroon Development Corporation (CDC). Both are expanding rapidly, and in contrast to Nigeria, sell their produce directly on to the World Market. Small-holders are supplied with seed by the Government and encouraged to plant oil palm near the estates and sell their fruit to the plantation for processing. Unilever Ltd., have two estates, Lobe and N'dian. The former has screw presses for oil extraction and the hydraulic presses at N'dian are also being replaced by screw presses. All the kernels and about half the oil production is exported. The remainder is utilised locally. The CDC estates are also expanding rapidly and currently have 17,000 hectares in production.

## PALM OIL REFINING AND FURTHER PROCESSING

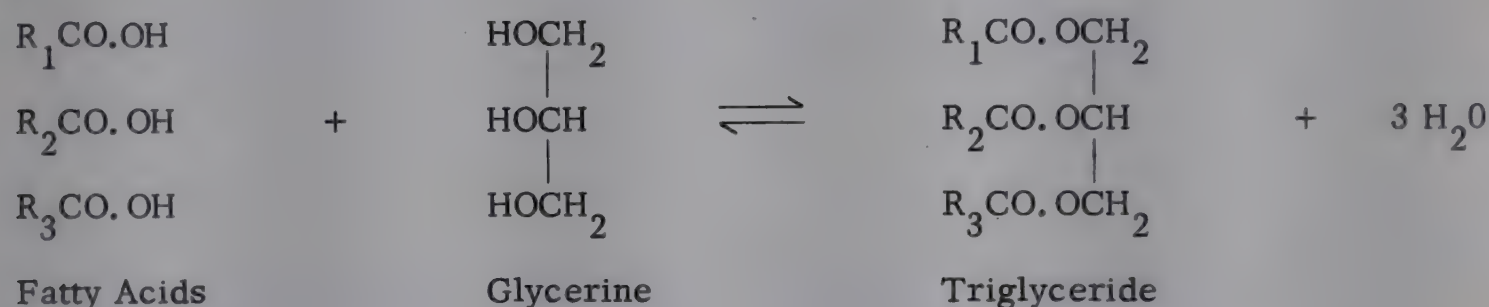
By J. A. Cornelius

Oil Palm Advisory Bureau

With increasing competition from other fatty oils, the processing of crude palm oil to yield more saleable products is likely to become of greater importance. The purpose of this note is therefore to provide those who are not oil technologists with some information on the processes involved.

The main components of palm oil are glycerides of fatty acids, in which, for the most part, three fatty acid molecules are attached to each molecule of glycerine. Since the oil contains several different fatty acids in varying proportions, and many different combinations of these fatty acids can be attached to the glycerine molecules, it will be realised that the glyceride composition of palm oil is complex (Figure 1):

Fig. 1



The range of composition of component fatty acids, together with iodine values and melting points, are shown in Table I for palm oil, together with certain other oils which are also used extensively for edible purposes, and which are competitors to a greater or lesser extent. It will be seen from the table that palm oil contains for the most part, the same fatty acids as are found in other oils and fats, but some of the others contain minor amounts of fatty acids (for example, linolenic acid in soya beans and cottonseed oil) which are not found in palm oil. The main differences between palm oil and other edible oils in the fatty acid composition are the varying proportions of saturated and unsaturated acids. The latter are responsible for the iodine value, since the iodine value indicates the degree of unsaturation. Higher iodine values accompany a lower melting range since unsaturated glycerides melt at lower temperatures than their saturated counterparts. It will be noted that palm oil has a fatty acid composition which is quite close to those of lard, tallow and hydrogenated whale oil and it resembles these more closely than the other oils in its general properties, being a solid fat at normal ambient temperatures in temperate climates, whereas soya bean, groundnut, sunflower and cottonseed oils are mostly liquids in such climates. The deep orange-red colour of liquid palm oil is due to the presence of carotenoid pigments, especially  $\alpha$  and  $\beta$  - carotenes, which, in Malaysia, usually total between 300 and 600 mg per kg. oil, while in West Africa, the total concentration of carotenoid pigment may be as high as 2,000mg per kg oil, but is usually around 1,000mg/kg. The other oils do not contain large amounts of carotenoid pigments. Not all the fatty acids found in crude oils are chemically combined with glycerine and these uncombined fatty acids are known as "free fatty acids". The glycerides can be split into fatty acids

TABLE I

Component fatty acids of palm oil and other commercial fatty oils

	Palm Oil	Lard	Hardened Whale Oil	Tallow (Mutton)	Soyabean Oil	Groundnut Oil	Sunflower Oil	Cottonseed Oil
<b>Saturated Acids</b>								
Lauric	-	-	42	-	-	-	-	-
Myristic	-	tr	-	-	-	-	-	-
Palmitic	0.5-5.9	0.7-1.1	-	1-4	tr - 0.3	-	-	0.5
Stearic	32-47	26-32	-	20-28	7-10	6-9	5-7	20-23
Arachidic	2-8	12-16	-	25-32	3-6	3-6	4-5	1-3
Behenic	-	-	-	-	0.3-0.9	2-4	0.2-0.3	0.2-0.4
Lignoceric	-	-	-	-	-	tr-3	0.6-1.4	-
	tr	-	-	-	-	1-3	tr-0.4	0.2-1.2
<b>Mono-unsaturated Acids</b>								
Myristoleic	-	tr-0.3	-	-	tr-0.1	-	-	-
Palmitoleic	-	2-5	-	-	tr-0.4	tr	0.1-0.5	-
Oleic	40-52	41-51	55(c)	36-47	17-57	53-71	16-34	23-35
Gadoleic	-	-	-	-	-	-	tr-0.3	-
<b>Poly-unsaturated Acids</b>								
Linoleic	5-11	3-14	3	3-5	28-57	13-27	55-71	42-54
Linolenic	-	tr-1	-	-	2-10	-	tr	tr-11
Arachidonic	-	1.4-3	-	-	-	-	-	-
Iodine Value (Wijs)	44-54	53-77	52.4	35-46	120-141	84-100	112-135(d)	99-113
Melting Point °C	27-50	33-46	34-42.8	44-51	-20 to -23	-2	-	-2 to +2

(a) Williams "Oils Fats and Fatty Foods" London: J and A. Churchill, 4th edn, 1966, page 207.

(b) Seltz, Fette Seifen Anstrich, 1969, 71 (6), 450.

(c) Including 32 per cent isomers of oleic acid.

(d) British Standard 1939: 1967.

and di-glycerides, mono-glycerides, and finally glycerine. This takes place when moisture is present by a process of hydrolysis or lipolysis.

### Refining

For edible use in industrialised countries, a fully refined palm oil is required. The refining steps normally carried out on the crude oil include:

- (a) Neutralisation, or removal of free fatty acids, either by conversion into soap with alkali in which form they are water soluble, or by steam stripping since these acids are volatile in steam.
- (b) Bleaching or decolourising either by absorption of the pigment on an activated earth, or by destruction of the pigment by heat.
- (c) Deodorisation or removal of odoriferous rancidity products by steam.

Removal of free fatty acids (ffa) is responsible for a direct loss of oil to the refiner, which usually is around  $1\frac{1}{2}$  times the percentage ffa. The development of ffa, as already mentioned, occurs through lipolysis, which may be caused by enzymes present in the fruit prior to extraction, through enzymes introduced by fungal growth, or by normal chemical hydrolysis. To minimise these factors, the harvested fruit must be sterilised as soon as possible and the moisture content of the extracted oil reduced to less than 0.1% before leaving the mill.

When the refined palm oil is to be used in applications where a nearly colourless fat is required, it is most important that the oil should be easy to bleach. This is somewhat less important when the oil is used for margarine manufacture. Bleaching problems occur when palm oil has become oxidised before it reaches the refiner. There is experimental evidence that enzymic oxidation can occur before the fruit is sterilised, and atmospheric oxidation of the oil after it has been extracted from the fruit is accelerated when the oil is heated and when the natural anti-oxidants (mostly tocopherols) have been removed or rendered inactive. Some tocopherols are removed when the oil is fully refined, including deodorisation, and the pro-oxidant action of certain metals, such as iron or copper, is believed to be due to the poisoning action on the anti-oxidants. Iron from processing machinery and storage tanks may be dissolved in the oil by the action of the free fatty acids, but the iron concentration is usually low when the free fatty acid is low.

### Modification of Palm Oil Properties

With modern technology, physical properties of fats, including palm oil, can be modified and there is a considerable degree of interchangeability between the various fats. Thus, unsaturated fatty acids can be converted into saturated fatty acids by hydrogenation, and thus the melting point of the fat can be raised and the plastic properties changed. This process is commonly known as hardening.

When a fat is heated with a catalyst under suitable conditions, the fatty acids attached to the different glycerine residues can change places with one another, a process known as inter-esterification. In natural fats, the various fatty acids are not distributed onto the glycerine molecules in a completely random way, but they follow a certain pattern. However, when inter-esterification is carried out, the fatty acids will normally become redistributed in a random fashion, and in the case of palm oil, when the process is carried to equilibrium, the fat has a higher proportion of both fully saturated and fully unsaturated glycerides than are found in natural palm oil, as indicated in Table II.

TABLE II

Glyceride composition of palm oils

	Observed	Randomised	Directed
Trisaturated	6	15	52
Disaturated-monounsaturated	48	38	-
Monosaturated-diunsaturated	43	36	-
Triunsaturated	3	11	48

When the inter-esterification is performed at about  $38^{\circ}\text{C}$ ., crystallisation of the high melting saturated tri-glycerides begins to occur, and, if the reaction is allowed to continue at the same temperature, the continued withdrawal of the least soluble portion of the reaction mixture by crystallisation, upsets the equilibrium and makes possible the production of a glyceride mixture having a composition considerably different from that obtained at equilibrium. Under such circumstances, the procedure is known as directed inter-esterification. Thus, in a reaction lasting for about 24 hours at this temperature, the fully saturated tri-glyceride portion of palm oil can be increased from about 6% to about 28% of the weight of the whole fat, a quantity at least twice as great as that produced without the influence of simultaneous crystallisation (Eckey 1954). In theory, if all the saturated fatty acids could be directed onto the same glycerol molecules, the proportion of fully tri-saturated molecules could be as high as 52% by weight for the samples shown in Table II.

Fractionation processes can be applied to palm oil to separate a predominantly saturated fraction from a less saturated fraction with a lower melting point, and various processes, including those involving cooling of the oil in a solvent (Bernardini and Bernardini 1969) have been applied to the semi-refined oil. In one experimental process, crude palm oil from the Far East, after bleaching to remove the carotenoid pigments, was fractionated to produce a liquid fraction representing 82% of the whole with a melting point of  $22-24^{\circ}\text{C}$ ., and a solid fraction with a melting point of  $56^{\circ}\text{C}$ . 82% of the fatty acids were saturated in the case of the solid fraction, whereas in the case of the liquid fraction, only 45% of the acids were saturated.

At the present time, the bulk of palm oil refining and modification is carried out in the importing country. Oil for export is normally transported in the crude state, and although there may be some advantage in partially refining the oil before export, including neutralisation and bleaching, deodorisation is inadvisable since this process removes some of the

natural antioxidants. The value of carrying out modification processes in an exporting country, of course, depends upon the market open to that country for such modified palm oil.

Another possible method for modifying the properties of palm oil is by breeding, although little attention has so far been paid to this aspect. However, experimental work is in progress in the breeding of hybrid palms between the West African and South American species. The mesocarp yield of the South American parent is much lower than that of the modern variety of the West African oil palm, but the composition of the oil is of interest since it possesses a considerably greater proportion of unsaturated fatty acids and a higher iodine value with a lower melting point than ordinary African palm oil. Oils from hybrid palms are intermediate in their characteristics and fatty acid composition. (Anon 1969 and Hardon 1969). It might be that palm oils modified in their composition by such breeding methods will produce a more desirable oil in the future.

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## OIL PALM MARKET SURVEY

### A REPORT BY THE COMMONWEALTH SECRETARIAT

Indications are that world commercial production of palm oil in 1971 may attain a new peak of some 1.2 million tons. Output in West Malaysia advanced rapidly in the first half of this year, totalling some 232,000 tons compared with only 168,000 tons in the same period of 1970, an expansion of 38 per cent. East Malaysian exports also rose, while Nigerian production in the first half of the year amounted to some 25,000 tons as against 14,000 tons in January-June 1970. However, preliminary figures for July indicated a marked slackening in Nigerian purchases of both palm kernels and oil. A development of some significance this year has been the expansion in production in the Ivory Coast, which is believed to have shipped some 20,000 tons of oil in the first half of the year as against under 3,000 tons in January-June 1970. Supplies from this source can be expected to grow rapidly in the next few years, as the large investments made in oil palm plantations since the early nineteen-sixties become productive.

The 17 per cent growth predicted for world palm oil production this year will not be matched by a similar rise in world palm kernel output. This is because the growing volume of palm oil production from new estates is accompanied by only relatively modest increases in kernel output, while in Nigeria, the most important single source of kernel supplies, the signs are that kernel output this year will be only marginally higher than in 1970. Tentatively, world kernel output is forecast as rising by only 3 per cent in 1971. Figures for the early months of the year showed a fairly substantial rise in kernel exports from Nigeria, but a modest fall in those of oil.

Prospects of some improvement in world edible oil supplies in 1971-72, combined with a slow market for soya products, owing to recent world currency uncertainties and strikes in the United States, have led to a weakening in world edible oil markets as compared with the high prices prevailing late in July. Malaysian palm oil values dropped from £118 per ton in August to £112 per ton in September, but nevertheless palm oil remained sold far ahead, the nearest shipment being for January-February, 1972. The outlook for palm oil is, moreover, still relatively favourable for although a further fall in values cannot be ruled out, it seems unlikely that quotations will in the foreseeable future fall below £100 per ton, still a very remunerative price to producers.

# Commercial production of palm kernel and palm oils

(Thousand tons)

	1968	1969	1970	1971 c
	oil equivalent a (kernels)	oil equivalent a (kernels)	oil equivalent a (kernels)	oil equivalent a (kernels)
<b>Palm kernels</b>				
Nigeria	89	89	137	141
Sierra Leone	25	25	27	26
West Malaysia	28	35	40	45
Angola	7	7	7	
Cameroun	11	8	8	
Congo (Kin.) b	61	52	61	
Dahomey	26	29	28	
Indonesia	18	19	22	
Ivory Coast	5	4	6	
Mexico	12	12	13	
Togo	6	9	8	
Other	35	34	37	
Total	323	323	394	406
				(865)
<b>Palm oil</b>				
Nigeria	4	25	25	45
East Malaysia				
(Sabah)	19	25	28	38
West Malaysia	261	321	396	520
Angola	12	12	12	
Cameroun	21	23	24	
Congo (Kin.) b	240	210	210	
Dahomey	10	14	16	
Indonesia	177	136	211	215
Ivory Coast	12	15	35	50
Others	48	57	70	
Total	804	888	1,027	1,200
				(865)

a Converted at 47 per cent oil content

b Estimates

c Forecast

Mid-month prices of palm oil, palm-kernels and palm kernel oil

(£ per ton, nearest forward shipment, c.i.f. U.K. ports, excluding duties)

	1969 Average	1970 Average	1970 Dec.	1971				
				April	May	June	July	Aug. Sept.
Palm oil, Malayan 5%	76.80 <u>a</u>	110.37	115.00	115.00	105.00	104.00	115.00	118.00 112.00
Palm kernels, Nigeria	64.98 <u>b</u>	70.98	76.00	63.00	56.75	59.50	61.75	59.75 57.50
Palm kernel oil, West African	129.58	155.64	173.00	141.00	127.00	132.00	149.00	142.00 131.00

b Resellers

a Average of 10 months only

The outlook for palm kernels and oil is probably considerably less assured than that for palm oil, since, contrary to earlier expectations, there has been a substantial increase in Philippine copra output this year which has significantly increased world lauric oil supplies, as is evidenced by the declining movement in kernel and oil values since July. At the time of writing the action of market forces seemed more likely to depress kernel and oil prices further than to raise them significantly.

## BOOK REVIEWS

TECNOLOGIA OLEARIA by E. Bernardini, Rome "Technologie" S.R.L., 1971, 800 pp, 23.5 x 16.5 cm, 306 diagrams and illustrations. Price Lit. 25.000

This book, in Italian, is written by a leading authority on the oilseeds and oils industry in Italy, who is also an executive of a leading processing plant manufacturer in that country.

It is almost inevitable that a book on oil technology should be compared with the American book on the same subject, namely "Bailey's Industrial Oil and Fats Products" (Rheinhold Publishing Corp.) which is considered to be a standard reference book for the industry.

In format, "Technologia Olearia" follows a similar pattern to Bailey's book and covers in three parts, the economics of establishing a factory for oilseeds and fats processing; the processing methods; and the classification and refining of both vegetable and animal oils and fats. A fourth part deals with fat constituents, analytical methods, tables of constants and conversion tables.

Parts 2 and 3 are the largest sections covering the processing of oilseeds with a general description and account of many commercially important seeds, to extraction by expression and solvents. Particular attention is given to the processing of olives and tomato and grape seeds, in the last chapters of Part 2. Part 3 deals in detail with the classification and refining of animal and vegetable fats and oils and includes a chapter on margarine.

The technical content of the various sections is very good and the chapters are well illustrated with photographs and diagrams. The theoretical considerations are possibly not so extensively covered as they are in Bailey's book and it is somewhat surprising to find in the chapter on the bleaching of oils that no mention is made of the methods for measurement of the colours of crude and bleached oils.

The book is well printed on good quality paper and well bound.

Inevitably there are some errors, mainly typographical. For example page 139 - grap seed and page 400 - sufflower oil; and Figures 171 and 178 (pages 371 and 385) are identical pictures of a drier in connection with two different products, a rather unnecessary duplication. A photograph of the same drier from a different angle might have been better.

Altogether, this is a most informative and useful book, obviously directed to the Italian industrial field of oils and fats. An English version would no doubt be most useful in the UK and other English speaking countries.

E. A. S.

OIL PALM CULTIVATION IN MALAYA - TECHNICAL AND ECONOMIC ASPECTS by C.N. Williams and Y.C. Hsu. Kuala Lumpur: University of Malaya Press, 1970 pp. xvii + 205 references 6½ pp., 22 plates, 33 figures. Price M\$35.00.

There can hardly be another major crop which has seen so much expansion in recent years as the oil palm, and the same is almost as true of its literature. Possibly this is as it should be, and it is therefore a virtue in some respects (although maybe a disadvantage in others) that this new book on oil palm cultivation firmly directs attention to crop production in Malaya - not even Malaysia, as Sabah, where much oil palm expansion is in progress, is hardly, if ever, mentioned.

The most interesting and in many ways the most refreshing aspect of the book is its division into two parts, each by a separate author, on "Technical aspects", by which is meant the usual gamut of the tropical agricultural textbook from climate and soils to harvesting, and on "economic aspects", a very welcome new idea in such textbooks, which deals with budgeting, record keeping and management from the non-agronomic angle.

After a brief, rather sketchy introduction the first part provides 12 chapters which deal with climate and soils (strictly Malayan and much in need of comparative data from other oil palm-producing areas), botany and the hybridization of dura and pisifera types (a very brief forward look into vegetative propagation makes no mention of the possibilities of tissue culture), nursery work and seedling selection (the latter containing some notable mathematics on relative growth rate possibly more suitable for a book on physiology than a manual such as this), and land preparation and planting (thorough and helpful with a useful bit on progressive thinning).

The next chapter on weed control has some useful material on chemicals but, alas, the author states that "it is not within the scope of this book to give a full account of all the weeds affecting planting in Malaya", whereas one would have thought that information on the actual weeds and how to kill them was just what was needed. Fertilizer use follows (with helpful notes on deficiency symptoms) and there is a further useful chapter on fruit production with advice on assisted pollination.

Harvesting at last, but only a very brief word on that difficult problem of the correct time to harvest, and nothing much either on the serious matter of deterioration on which the quality of the oil depends so much. Finally pests and diseases are discussed, rather cursorily - possibly because other books exist on these subjects.

The "economic aspects" now concern the reader and, in this reviewer's opinion, the five chapters really boil down to two which are directly useful to the planter or agricultural student. These are the third on budgeting and the fourth on record keeping, both full of excellent practical advice for those who find these mysteries far more abstruse than the mathematics of relative growth rate. The first two chapters of this second part, on the role and need of management and economic principles essential to better management, and the last, on profitability and economic prospects, have a tendency to vary from platitudes to pure economic theory, in that order.

The bibliography is a short one and the more recent literature is inconspicuous; here again one has the feeling that the authors would have done better to have widened their horizons a little further.

The book itself is nicely produced and illustrated, but spelling errors are not few (Phytopthera, Thielviopsis, Armillaria mella, weedozol, Grammoxone, Mikenia, R. R. I. of Malaysia are some examples) and it does have lacunae such as deterioration and storage, field processing, information on products and by-products, and their composition. Nevertheless, it is unquestionably a useful book for anyone growing oil palms in Malaya. Those concerned with oil palm growing elsewhere, and this is an increasing number, will also find this a helpful book to possess and one which they will often turn to for practical and reliable advice.

G. E. T.

## RECENT PUBLICATIONS

### Ghana

#### OIL PALM BREEDING AND SEED PRODUCTION IN GHANA

(H. A. M. van der Vossen, Ghana J. Agric. Sci., 1969, 2 (2), 81-90)

Domestic production of palm oil (8000-10000 t/year) is inadequate to meet internal demand estimated at 60,000-80,000 t/year. The principal work of the Oil Palm Research Centre (OPRC) near Kade is therefore the production of high quality seed as planting material. A breeding and seed production programme similar to that at NIFOR is in progress. About 150 acres of breeding and selection fields have been planted and pollination techniques used are an adaptation of those used by NIFOR and IRHO, (dura and Deli dura x pisifera hybrids). Present production of seed is 1 million. It is expected that the OPRC alone will produce an estimated 3 million special grade seeds by 1970, sufficient to meet demand.

#### THE SAP OF THE OIL PALM AS RAW MATERIAL FOR ALCOHOLIC FERMENTATION IN GHANA.

(G. K. Sodah Ayernor and J. S. Mathews, Trop. Sci., 1971, 13 (1) 71-80).

Palm sap as tapped by the traditional Ghanaian method was examined for carbohydrates. The fermented sap was examined for acidity, volatile acids, and ethanol content. Some alcohols of the fermented sap were identified. The tapping methods employed in Ghana and Nigeria are described and compared.

#### NUTRIENT STATUS AND FERTILISER RESPONSES OF OIL PALM IN THE FOREST ZONE OF GHANA.

(H. A. M. van der Vossen, Ghana J. Agric. Sci., 1970, 3 (2), 109-129).

Climatic requirements and topography restrict economic oil palm production in Ghana mainly to the Forest Oxysols and Forest Ochrosol-Oxysol intergrades developed over granites. Yield records over 8-12 years together with foliar analysis data have shown P and K deficiencies in oil palms on soils of all three geological formations. Consistent and highly significant yield responses of 30-35 per cent to phosphate fertiliser applications were found in an experiment on soils over Tertiary Sands and in one trial on soils over granites, while both experiments also showed a significant K effect in some years. There are indications that under conditions of light soils, and excessively high rainfall, special precautions have to be taken to preserve a satisfactory fertility status of these soils. Tentative recommendations on type, rate and frequency, time and method of fertiliser application are given.

## AREAS CLIMATICALLY SUITABLE FOR OPTIMAL OIL PALM PRODUCTION IN THE FOREST ZONE OF GHANA

(H. A. M. van der Vossen, Ghana J. agric. Sci., 1969, 2 (2), 113-118)

Average annual rainfall and mean annual water deficit data of some 30 stations in the forest zone are presented. Three of the four existing oil palm plantations in Ghana are shown to be situated in marginal areas and the fourth and largest (Pretsea) is also outside the climatically favourable area. Tentative estimates of bunch yield are 12-15 t/ha (5/6 t/acre) at maturity when the average annual water deficit is below 250 mm.

### Ivory Coast

## THE USE OF COMPUTERS FOR THE PROCESSING OF INFORMATION FROM OIL PALM SEED BLOCKS AND EXPERIMENTAL FIELDS

(Anon. Information Systems Magazine, Spring, 1971)

The interpretation of the results of work and experiments carried out by the Institute for Research on Oils and Oilseeds (IRHO) has always been done in Paris by the statistical section which is under the Department of Research and Experimental Stations. These results have been categorised in this department and then processed by computer by a service bureau.

In 1970, the department acquired a computer complete with magnetic film memory, printer and auxiliary film card and verification equipment and card sorter. Agronomic experimentation and selection data from La Mé in the Ivory Coast can now be processed quickly in Paris.

This means a much faster possibility of intervention and more flexible management. More thorough administration of planting, and, as a result, errors which are now more easily detected can be discovered at various stages in planting. The computer allows the development of similar research on other sites, and also completely new research can be undertaken. This was not possible until now either because it represented too much work under the old organisation or basic data was not available to researchers of the Institute.

## THE CASTRATION OF YOUNG OIL PALM INFLORESCENCES IN THE IVORY COAST

(B. Taillez and J. Olivin, Oléagineux, 1971, 26, (3), 141-152)

[English and Spanish summaries 12 lines].

A new castration experiment carried out in the Ivory Coast (La Mé) on 1963 plantings confirms preceding results. In spite of a later start to harvesting, the castrated palms at 5 years old produced more than non-castrated palms, and the bunches of the castrated palms were larger. Later, because of a recessive effect, the yields of castrated and non-castrated palms became equal at 7 years old.

The economic return is difficult to calculate, but without any increase in labour costs it enables in effect the harvesting over a shorter period of larger bunches more evenly spread throughout the period. The extraction rate is probably improved as well.

## WATERING OF OIL PALM NURSERIES IN POLYBAGS

(P. Coomans, Oléagineux, 1971, 26 (5) 295-303)

[English and Spanish summaries, 5 lines]

In many oil palm growing regions, in particular in the lower Ivory Coast, extra watering in the nursery is a condition for obtaining vigorous young plants, transportable at 7 or 8 months old.

In the case of polybag nurseries, the sprinkler system is the best adapted method and the most economical above a certain annual planting programme. The article describes all the data which have to be taken into account when estimating and setting up a sprinkler system.

## Malaysia

### A CASE OF SERIOUS DAMAGE BY THE RED-BELLIED SQUIRREL IN YOUNG OIL PALMS

(Brian Wood et al., The Planter, 1970, 46, (537), 414-424)

Extensive damage by small mammals occurred on about 200 acres of young oil palms. The animals ripped the fronds in a ragged fashion at the hearts. Some recovering palms were reattacked. Observation, trapping and hunting showed that the red-bellied squirrel (Calloscurus notatus), the wood rat (Rattus tiomanicus) and the tree shrew (Tupaia glis) were all common in the area but examination showed squirrels to be largely responsible. Rat control with KG22 bait was carried out but was not effective against squirrels. Wire guards at the base of the palms stopped the damage.

### "KULIM SYSTEM" OF HARVESTING PALM FRUIT

(Anon., The Planter, 1970, 46 (537), 433)

The 24 hour a day "Kulim System" is feasible and economically attractive and is an ideal system for the large scale collection and transportation of the fruits from the field to the mill.

The technique is by using nets, conveyance and crane. The empty nets are distributed along the roadside in the field. The harvesters continue to cut and place the fresh fruit bunches and the loose fruits on the loading nets at pick up points. The truck or other suitable conveyance fitted with a crane then lifts the fully loaded net and the fruit is released into the truck. It continues to various pick-up points until the truck is full before delivery to the mill. The use of nets saves time, reduces storage and prevents bruising and can be operated for 24 hours in the peak period by using spotlights.

CULTIVATION OF PADISTRAW MUSHROOM USING OIL PALM BUNCH WASTE AS A MEDIUM.  
(N. Raja Naidu, The Planter, 1971, 47 (542), 190-193)

The straw mushroom is an edible tropical fungus popularly cultivated in the South East Asian regions of Thailand, Burma, Philippines, Indonesia, Hong Kong and Malaysia. In addition to straw, as a growing medium, the straw mushroom can be cultivated on oil palm bunch waste which is readily available throughout the year. Mushrooms can be cultivated in open areas at low capital cost and good strains of spawn are available from the Department of Agriculture.

PRODUCTIVITY OF THE OIL PALM IN MALAYSIA

(R.H.V. Corley et al, Expl. Agric. 1971, 7 (2), 129-136)

Crop growth rate, leaf area index, net assimilation rate and harvest index were estimated for oil palms in nine age groups growing on coastal alluvial soils in Malaysia. The mean crop growth rate of mature palms was 29.83 t/ha/yr with a Leaf Area Index of 3.61 and Net Assimilation Rate was 0.16 gm/dm<sup>2</sup>/wk. Photosynthetic efficiency was about 2.2 per cent. Oil constituted about 17 per cent of total dry matter production. Possibilities for improving the yield of oil are briefly discussed.

PALM OIL - TOWARDS INCREASING END CONSUMPTION

(Marshall Pike, J. Min. Com. & Ind., Malaysia, 1970, 3 (31), 13-18)

During the ten years from 1957-1967, world production of palm oil remained virtually static, while exports, partly owing to unrest in Nigeria and the Congo towards the end of this period, actually declined.

In 1966 Malaysia had become both the largest producer and exporter of palm oil and in the three years since then the upward trend has gathered momentum. During the next ten years further massive increases could be expected and by 1980 world production seems likely to be in the region of two and a half million tons of which more than one million will be contributed by Malaysia. The percentage of world exports of oils and fats which include palm oil will have to rise to around 9.0 per cent if these increased tonnages are to be absorbed into overseas consumer markets. It will be necessary to spend considerable time and energy upon increasing the end consumption of palm oil if its level of profitability is not to be reduced. Palm oil will face intense competition from other vegetable oils and will only be able to maintain its position if its price in competition with alternative oils and its quality is acceptable to the consumer.

PRACTICAL EXPERIENCE IN POLLEN COLLECTION AND DRYING ON A SMALL SCALE  
(T.A.T. Leitch, Oléagineux, 1971, 26 (5) 305-306 in English)  
[French and Spanish summaries, 4 lines]

The method was devised on the plantation at Bukit Rajah, Klang in Malaysia. A large part of this plantation lies on coastal clay of the Selangor series, and the replanting of former rubber zones with oil palm, started in 1961, is now being completed. The author shows how to collect, condition and store the pollen from these recent plantings. The cost per lb. of pollen, inclusive of drying, averages \$ 1.14 and monthly costs range from 93 cents to \$ 1.37 per lb.

### Nigeria

OILS AND FATS: COMMON MARKET THREAT RECEDES  
(Anon West Africa, No. 2823, 23 July 1971, p. 833)

Lack of progress towards a world pact covering vegetable oilseeds and oils was reported recently by the Secretary General of the UN Committee on Trade and Development, but West African producers of these commodities can take heart from a more significant development in the world market - the disappearance of the EEC butter surpluses. Sales of margarine made from vegetable oils are increasing as butter becomes scarcer and thus more expensive. At the same time prices of vegetable oils and fats have been steadily rising. Fluctuations are inevitable but there are two particular dangers here. Firstly in a trade in which interchangeability of oils and fats is so easy, markets lost are not easily regained. Secondly, the repercussions on the developing countries' own seed-crushing industries are severe because unlike Western Europe, the scope for turning to alternative oilseeds is more restricted.

In the long term, the importance of the developing countries as consumers of oilseeds and oilseeds products will be increasing, while their relative importance on the supply side will decrease.

One effect of this trend will be that countries such as Nigeria and other major West African oilseed producers will want to do even more processing themselves instead of sending the seeds abroad and importing finished products.

Nigeria has already had the experience of palm oil which has been a major export crop and major food item in the Federation. The industry is in serious decline and it is estimated that by 1980 home consumption will be about 800,000 tons compared with an estimated production of 500,000 tons. Nigeria might be faced with a complete loss of a valuable export crop and may have to import palm oil from the Ivory Coast or Malaysia.

# STUDY OF COROZO OLEIFERA x ELAEIS GUINEENSIS HYBRIDS

(Anon, Nigerian Institute for Oil Palm Research, Quarterly Progress Report, No. 73, April-June 1970, page 9)

Fourteen bunches of *C. oleifera* and *E. guineensis* hybrids were analysed during the quarter and the average results are shown below:

## Fruit Analysis

Pulp to Fruit	57.9%
Nuts to Fruit	37.81%
Oil to Pulp	46.47%
Oil to Fruit	32.95%

## Oil Analysis

Carotene (ppm)	1027
Iodine Value	62.13
FFA (%)	1.27
Peroxide Value	0.08
Sap Value	192.39
Density at 60°C	0.897

## OIL PALM PROJECT IN DANGER

(Anon, West Africa, 1971, (2816), p. 635)

Lack of transport is jeopardising the success of a two year USAID oil palm rehabilitation scheme in Nigeria's war affected areas. USAID is planting fourteen nurseries at NIFOR and it is the responsibility of the Nigerian States Governments to collect the seedlings from NIFOR but there is such an acute shortage of transport in the States concerned that the seedlings are not being distributed to the farmers.

Particular concern is being expressed about the difficulties surrounding the successful implementation of this project because of the inadequate progress of the industry as a whole. There are fears that unless trends are reversed, Nigeria may be importing palm oil by the 1980's although it was the world's foremost exporter until 1962.

## STUDY OF COROZO OLEIFERA x ELAEIS GUINEENSIS HYBRIDS

(Nigerian Institute for Oil Palm Research, Quarterly Progress Report, No. 74, July-September 1970, page 9).

The average result of analysis of fifteen bunches was as follows:

## Fruit Analysis

Pulp to fruit	66.02%
Nut to fruit	31.26%
Oil to Pulp	40.72%
Oil to fruit	27.06%

## Oil Analysis

Carotene (ppm)	854
I. V.	63.64
Sap value	196.01
Density at 60°C	0.898

## General

### EFFECTS OF HARDENED PALM OIL ON RAPESEED OIL-INDUCED CHANGES IN DUCKLINGS AND GUINEA PIGS

(R. O. Vles and A. M. Abdellatif, Proceedings of the International Conference on the Science, Technology and Marketing of Rapeseed and Rapeseed Products, Ste Adèle, Canada, Sept. 1970, Rapeseed Association of Canada, Ottawa)

Growth retardation, histopathological changes in myocardium, liver and spleen and haematological anomalies have been observed in ducklings and guinea pigs on feeding high concentrations of rapeseed oil. These effects are ascribed to the erucic acid content of this oil.

The influence of hardened palm oil on the effect of rapeseed oil in guinea pigs and ducklings has been studied by feeding them isocaloric fat mixtures containing constant amounts of erucic acid and varying levels of palmitic acid.

In guinea pigs, an increase in the amounts of hardened palm oil in the rapeseed oil diet, resulted in an improvement of spleen and liver morphology as well as of the values of haemoglobin content, packed cell volume and thiourea haemolysis.

In ducklings, however, the palmitic acid rich diet did not correct all the effects of rapeseed oil; it improved growth, decreased the hydropericardium, spleen and liver changes but had no significant effect on the changes of heart and skeletal muscles.

### RESEARCH FOR OIL PALM QUALITY CRITERIA

(M. Servant and Y Bagot, Oléagineux, 1971, 26 (3), 169-173)  
[English and Spanish summaries, 7 lines]

The quality of palm oil depends on its acidity, water and dirt contents, as for other fats. Other characteristics of interest include the following: Carotene content, the degree of oxidation, stability and fatty acid composition. The carotene content, bleachability and variation in peroxide value during accelerated oxidation tests of some samples from industrial plantations in Africa and Latin America are examined. A comparison is made with samples from oil mills situated in wild palm groves.

PALM OIL BULKING AND SHIPPING AND SOME RELATED CHANGES IN QUALITY  
(L. F. Natta, Oléagineux, 1971, 26 (5), 337-342)  
[English and Spanish summaries, 12 lines]

Palm oil reaches port bulking installations with certain quality characteristics. Handling of the oil in and out of the installation must be organised in a manner allowing as little deterioration as possible. A survey was undertaken of the development of free fatty acid content and peroxide value for oil delivered by eleven producers into a 12,000 ton storage installation. The implications of the recorded increase in FFA values and peroxide value on handling procedure in the bulking installation are discussed.

THE EFFECT OF ANALYTICAL PROCEDURE ON THE DETERMINATION OF PALM OIL  
DIRT CONTENT

(E. Ganda Kentjana and Benny Hendra Weko, Oléagineux, 1971, 26, (5), 333-335)  
[English and Spanish summaries, 8 lines]

Due to supply difficulties in recent years, there has been no uniformity in the methods of analysis for quality control of palm oil in Sumatra, with the result that there has been much variation in data. Investigations into the impurities content were made, using different solvents and filter media. It was concluded that standardisation of analytical procedures for quality control of palm oil is very desirable, particularly regarding the solvent and pore size of the filter used in dirt determination.

## TRAINING AND INFORMATION

The Bureau is prepared to advise management in the oil palm industry on the training of personnel. Details of the nationality, linguistic abilities and educational background of the candidate would be needed, together with the purpose for which training is required. Information is available about the funds which can be provided to assist in training and the Bureau can advise on how such assistance may be obtained.

The Tropical Products Institute has one of the world's best libraries of periodicals and works of reference dealing with the products of developing countries and photocopies of articles dealing with the oil palm can be provided on request. Answers to technical queries concerning the oil palm can also be dealt with; certain agronomic or engineering inquiries might have to be referred outside the Institute, but the Secretary of the Bureau would endeavour to find the best source of information.

In general, no charge will be made for any of the services provided but, if in a specific instance any charge has to be made, the inquirer will be notified in advance before he is committed to any costs.

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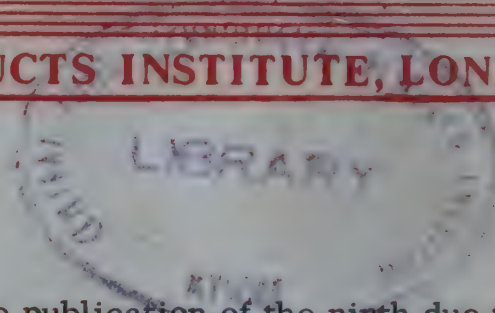
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# OIL PALM NEWS

**OIL PALM ADVISORY BUREAU, TROPICAL PRODUCTS INSTITUTE, LONDON.**



## EDITORIAL

The present issue is a double one consequent upon the late publication of the ninth due to an industrial dispute.

Included in this issue is a contribution from Sweden on the evaluation and prediction of palm oil quality from the users' view point. An article from the Netherlands reviews possible methods of handling and disposal of oil palm mill effluent and makes practical recommendations. This problem is becoming increasingly important with the increase in the size and number of mills and the current world-wide concern about river pollution by industrial wastes.

New research laboratories have recently been opened in the United Kingdom for both palm oil and rubber by Harrisons and Crosfield Ltd at Camberley in July 1970 and by Guthrie Estates Agency Ltd at High Wycombe in March 1971. It is anticipated that these laboratories will contribute much valuable information on palm oil processing and quality.

The Commonwealth Secretariat report in this issue indicates that the average price of palm oil in 1970 was 44 per cent higher than in 1969 and, although there was a low point last September, prices have since risen and touched £119 per ton in February 1971. The reference to figures indicating the build up of stocks in Malaysia due to lack of shipping is confirmed from commercial sources and suggests that the palm oil production increase has taken shippers by surprise. It is understood that the situation has eased to some extent but it highlights the need for production increase to be accompanied by increased handling, storage and transport facilities.

The final date for the receipt of articles and comments for the 12th issue, due to appear in November 1971, is the 6th September.



## CONTENTS

	Page
Editorial	(i)
Raymond Arthur Bull	1
Evaluation and Prediction of Palm Oil Quality	2
The Treatment and Disposal of Palm Oil Mill Effluent	23
Cold Oil Extraction in Oil Palm Bunch Analysis	25
Oil Palm Market Survey	32
Book Reviews	36
Recent Publications	38
Training and Information	52



## RAYMOND ARTHUR BULL

Oil palm research has seen no more colourful or inspired a figure than Raymond Bull who died suddenly in March of this year while still in his early forties. His knowledge and scientific interests were all-embracing. After appointment to WAIFOR (now NIFOR) in 1951 as a Plant Pathologist he immediately became involved in the study of deficiency symptoms and plant nutrition but found time also to investigate the biology of leaf-eating caterpillars. His discovery of the symptoms and cure of magnesium deficiency of the oil palm in 1952 was characteristic. Confronted with an estate at Calabar showing catastrophic "orange frond" symptoms, he immediately set up systematic injection and leaf spraying trials with as many chemicals as he could lay his hands on, some taken from the estate dispensary (he was over 300 miles from his own laboratory). The almost immediate responses to Epsom salts were announced to his Director by telegram.

This early work led to the setting up at WAIFOR of a Nutrition Division of which Raymond took charge. The work of installing the special apparatus for sand and water purification was often frustrating, but eventually he was able to determine and to publish the seedling deficiency symptoms of all the major and many of the minor elements. In the meantime his interest was diverted to leaf analysis and his laboratory was considerably expanded to accommodate the routine work involved.

Raymond left WAIFOR in 1960 and, after a short period in East Africa, was appointed to take charge of oil palm research at Chemara Research Station in Johore, Malaysia, later becoming Director of the station. It took time for the Malayan planting milieu to assimilate Raymond and to appreciate his unusual gifts. His real worth to Malaya was, however, soon established both within and without his own Company, as a recent tribute by four colleagues (The Planter, April 1970) bears witness. In particular he gained the unqualified respect and affection of other research workers engaged in studies of the oil palm. Discussion of any subject with him could be guaranteed to act as a tonic, and at Layang Layang he and his wife, Mary, always gave a ready welcome to oil palm enthusiasts from wherever they came. His own special contributions in Malaysia were in the field of nutrition and in his collaboration with Dr. Peter Turner in the composition of the invaluable "Diseases and Disorders of the Oil Palm in Malaysia".

Raymond was appointed Chief Research Officer to the Government of Uganda in 1968 but ill-health forced him to return to England in 1969. He will be greatly missed by many, but especially by those who valued his honesty of purpose and stimulating ideas.

C.W.S. H.

# EVALUATION AND PREDICTION OF PALM OIL QUALITY

by G Johansson and U Persmark, Karlshamns Oljefabriker, Karlshamn, Sweden

## Introduction

In the production of oils and fats for edible purposes one essential criterion must be fulfilled, namely the quality of the product must be considered satisfactory by the consumer.

In general terms two major aspects of the quality of oils and fats should be considered. One is strictly economic and related to the yield of refined oil, ie content of free fatty acids, water, dirt etc. Such figures are usually included in trade contracts between seller and buyer and do not normally cause any difficulties. The other aspect of quality, which will mainly be dealt with here with special reference to palm oil, concerns flavour, taste, appearance etc. These characteristics differ from the former primarily because they are of a subjective character and related to the organoleptic acceptance and stability. Although it may be stated that this kind of quality can never be evaluated completely objectively it should however be stressed that it is important to formulate criteria which, by experience, have been shown to be related to such quality factors and which, furthermore, can be understood and accepted by those directly concerned, eg producers and consumers or sellers and buyers. We, as consumers of crude palm oil, wish to know which qualitative characteristics can be formulated and applied to the crude oil in order to obtain an end-product of acceptable quality?.

Broadly speaking, the amounts of oxidized material present in the oil approximately reflect the actual quality of the oil. The tendency to form such compounds is related to the stability.

Factors such as oxygen, temperature, light etc. which influence oxidation may be characterised as external and indicate the quality of the oil with respect to processing and treatment. Other factors can be characterised as constitutional, ie natural contents of compounds that readily oxidize. The most obvious non-glyceride compounds of palm oil, which are responsible for the characteristic red colour, are the carotenoids. These highly reactive constituents are assumed to be of primary importance in the oxidative deterioration of palm oil. Pro-oxidative and anti-oxidative systems operating in the oil must also be taken into consideration.

## Methods

Generally speaking, methods that consider only the actual oxidation level are regarded as less accurate for predicting quality than those which consider more extensively factors that influence the oxidative deterioration rates, eg stability tests. Numerous methods for predicting the quality of oils and fats have been described in the literature (for a review see ref 1). The methods can be divided into two main groups, viz those measuring the actual amounts of oxidized material, group A (table I) and those measuring the tendency to form such oxidized material, group B (table II).

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Table I

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The benzidine value (BV) (2) has been used rather extensively in Sweden in combination with the peroxide value (PV). Benzidine reacts with secondary oxidation products (primarily unsaturated carbonyls) and has been shown to be useful for predicting the quality of oils and fats and their products, eg margarines. In table II normal levels for some common oils and fats after deodorization are shown.

Even if it emphasised that these figures should be compared with great care, it will be noticed that palm oil shows a considerably higher benzidine value than the other oils.

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Table II

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For a description of the total oxidation level based on BV and PV the following empirical rule may be useful:  $BV + 2 \times PV = \text{"TOTOX"}$  (total oxidation level). Figure I shows that in the absence of air the "TOTOX" value remains "constant", which would appear to support the use of such a rule.

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Figure I

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The relation between panel scores and oxidation (measured as BV) in deodorized palm oil is shown in table III (and figure 2).

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Table III

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Figure 2

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### Ultra-Violet Absorption

Measurement of the ultraviolet absorption for the evaluation and prediction of oil quality originates from studies of fat oxidation mechanisms (3). It was thus confirmed that auto-oxidation reactions are associated with conjugation of the double bonds. These reactions will thus appear as an increase of absorption in the 200-400 nm region due to the formation of primary as well as secondary oxidation products. Measurement of these spectral effects has been adopted by several authors for studying the effect of oxidation on oil quality (4-10).

The method seemed to have certain advantages, and we thus initiated a systematic study according to the procedure described in the appendix.

Since we are chiefly familiar with benzidine and peroxide values, we first established the relationship between these values and the results of the UV measurements. Figures 3:1 and 3:2 show these relations for a crude palm oil stored during a period of 12 weeks at 60°C. Figure 4 illustrates the relations between TOTOX (= BV + 2 x PV) and  $1000 \times (a_{235} + a_{270})$  (see note) for about forty different crude palm oils. The relation between a stability test (AOM) and the ultraviolet absorption intensities of the same crude palm oils as in figure 4 is shown in figure 5. Although there is a certain amount of scatter, there seems to be a clear correlation between low ultraviolet absorption and high oxidative stability/high panel scores.

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Figures 3:1 and 3:2

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Figure 4

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Figure 5

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#### Controllable Quality Factors

By experience it can be stated that a certain quality level of the refined oil corresponds to a certain minimum quality of the crude product. The quality of the end product (fully refined oil, margarine etc) is however not solely dependent on the nature of the crude oil. Furthermore it will also depend upon the treatment of the oil during processing.

An approximate indication of the development of oxidation of palm oil is given in table IV. For European plants in general the time lapse between the production of crude palm oil and its further processing after delivery is often considerable, and it will be noted in table IV, that the total increase of oxidation due to storage and transportation is almost 15 units. This indicates the importance, not only of suitable storage conditions, but also of careful production of crude oil, since production methods may significantly affect the rate of oxidative deterioration even though this is not always apparent from the existing oxidation values. (See also table V).

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Table IV

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A laboratory investigation illustrates quite clearly the effect of various handling conditions on quality (Table V).

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Table V

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Heat treatment decomposes peroxides, and table V shows that after refining the PV-values have been brought down to nil and thus give no information concerning the quality status of the oil. This further stresses the fact that PV-values are not always sufficient for characterisation of the oil quality.

Besides quality characteristics such as oxidation, colour is considered to be an essential quality factor. Owing to its natural content of coloured material, palm oil is of especial interest in this field. For evaluation of the extent to which the colour can be removed during processing, bleaching or bleachability tests are frequently used.

Initially three different methods were studied, namely:

1. Heat bleaching followed by bleaching with active earth<sup>1)</sup>
2. Bleaching with active earth (5%)<sup>2)</sup>
3. Bleaching with active earth followed by heat bleaching<sup>3)</sup>

The results of this comparison are summarised in table VI

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Table VI

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Subsequently a fourth method was formulated which may be considered a modification of method 2, in which 3 per cent active bleaching earth was used, and which was found to be best related to actual plant conditions (table VII).

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Table VII

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1) Based on method proposed by Miss Jacobsberg, Tropical Prod. Sales, Brussels.

2) Based on method proposed by J A Cornelius, Tropical Prod. Inst., London.

3) Based on method proposed by J Bibby Food Prod. Ltd., England.

The conclusions regarding bleachability tests may be briefly summarized as follows:

1. The method chosen should be closely related to present plant processing conditions.
2. Bleachability seems to be correlated to oxidation quality level (Table VII). Table VIII shows further the relationship between residual colour of plant-deodorised oil and oxidation values, which may also be considered to confirm this bleachability - oxidation relation.
3. Differences in bleachability are comparatively small within a limited quality interval.
4. As a consequence of 2 and 3 the practical need for a bleachability test is questionable if other quality specifications are established.

Table I

Analysis of oxidative characteristics in oils and fats.

Type	Object of measurement	Method/Analysis
A:1	"Primary" oxidation products	Peroxide value
A:2	"Secondary" oxidation products (reagents: DNPH, TBA, Benzidine etc.)	"Carbonyl value"
B	A:1 and A:2 versus time	Stability/keepability value

Table II

Normal levels of analytical characteristics of some deodorized oils and fats.

Oil/Fat	Free fatty acid %	Colour <sup>1)</sup>	Benzidine value <sup>2)</sup>	Peroxide value <sup>3)</sup> (mekv./kg)
Coconut oil	0.02	13	0.3	0.0
Rapeseed oil	0.03	11	2	0.0
Soyabean oil	0.03	11	2	0.0
Peanut oil	0.03	13	3	0.0
Hydrogenated fish oil	0.03	25	1.5	0.0
Hydrogenated rapeseed oil	0.03	10	1	0.0
Palm oil	0.04	35	9	0.0

1) Lovibond: Yellow + 10 x red (5 1/4").

2) IUPAC II D 15.

3) AOCS Cd 8-53.

Table III

Taste panel scores of deodorized palm oil in relation to benzidine value ranges.

Benzidine value range	1) Time lapse	2) Flavour score	Number of samples	Standard deviation
2.5 - 5.0	0	2.78	9	0.228
	24	2.32	5	0.148
5.1 - 7.5	0	2.60	39	0.401
	24	2.36	7	0.162
7.6 - 10.0	0	2.58	43	0.233
	24	2.18	14	0.185
10.1 - 12.5	0	2.53	29	0.400
	24	2.19	11	0.212
12.6 - 16.0	0	2.40	11	0.195
	24	1.85	4	0.191

1) Hours after deodorization (storage temperature : 50°C).

2) Ten grade scale : 0.5 - 5.

Table IV

Changes in oxidation values of palm oil : Fruit → deodorized oil.

Sampling (place/processing step)	BV	PV	"TOTOX"	Changes in "TOTOX"
Initial value (fruit)	1	0	1	
After pressing	3	0	3	+ 2
After drying	5	3	11	+ 8
(Storage)				
Storage tank (before shipping)	6	6	18	+ 7
(Transport)				+ 8
Pipe line (at delivery)	10	8	26	

Table V

Analytical characteristics of palm oil after various storage conditions on a laboratory scale.

REFINED PALM OIL													CRUDE PALM OIL				
Sample	PV	BV	FFA	a <sub>235</sub>	a <sub>270</sub>	Spect. colour 450 <sup>1)</sup>	PV	BV	a <sub>235</sub>	a <sub>270</sub>	Spect. colour a <sub>450</sub> <sup>1)</sup>	Colour Lovibond (5 1/4")			AOM (hours)	Panel score	
												Yellow	Red	Total Y+10xR		0 hour	24 hours
1	6.3	7.2	2.84	0.129	0.051	0.074	0.2	4.7	0.131	0.092	170x10 <sup>-6</sup>	17.0	1.8x10	35.0	62	2.6	2.0
2	8.6	7.7	2.87	0.133	0.044	0.075	0.0	2.1	0.159	0.076	136x10 <sup>-6</sup>	11.0	0.5x10	16.0	53	2.9	2.4
3	34.5	13.2	2.99	0.825	0.117	0.017	0.0	31.8	0.364	0.568	345x10 <sup>-6</sup>	50.0	3.0x10	80.0	37	2.2	1.5
4	27.9	13.7	3.13	0.758	0.118	0.024	0.0	28.4	0.352	0.522	310x10 <sup>-6</sup>	50.0	3.0x10	80.0	39	1.7	1.4

1) Absorbance at 450 nm (1g/1 x cm).

Table VI

Bleachability expressed as residual colour (% rel.)

Method		Step	Crude palm oil			Neutralized palm oil			
			Colour			Colour			
			Spectr.		Lovibond	Spectr.		Lovibond	
			<sup>a</sup> <sub>400</sub>	<sup>a</sup> <sub>450</sub>	I	<sup>a</sup> <sub>400</sub>	<sup>a</sup> <sub>450</sub>	I	
1	2)	heat	15.4	1.8	33.1	9.8	1.0	21.6	
	a	earth	8.0	0.6	12.8	5.0	0.5	10.2	
	b	heat	18.6	2.3	33.1	13.1	1.3	19.7	
		earth	9.4	0.7	12.4	7.0	0.5	9.5	
	2	a	earth	1.9	0.3	4.3	1.5	0.2	3.6
		b	earth	1.8	0.3	4.1	1.3	0.2	2.9
3	a	earth	54.7	32.6	70.4	50.0	25.8	67.3	
		heat	9.9	1.3	20.2	8.8	1.0	14.3	
	b	earth	51.6	30.4	70.4	48.4	25.8	67.3	
		heat	7.1	0.9	21.9	6.6	0.7	13.4	

1) Methods according to text.

2) Duplicates.

Table VII

Bleachability expressed as residual colour (rel. % of initial colour) of five different palm oils.

Palm oil specimen	FFA %	PV	BV	UV absorbance (1g/1xcm)		Colour					Metal content (ppm)		Residual colour (%)			
						Lovibond (1")			Spectr. 1)							
				a <sub>235</sub>	a <sub>270</sub>	Y	R	Y+10xR	a <sub>450</sub>	a <sub>400</sub>	Fe	Cu	a <sub>400</sub>	a <sub>450</sub>	Spectr.	a
1	2.2	13.0	17.1	0.286	0.081	40	21	250	0.141	0.066	4.2	↑	6.4 5.7	0.9 0.7	10.2 11.5	11.2 10.8
2	2.7	3.4	8.0	0.109	0.051	40	24	280	0.149	0.067	2.5	↓	2.2 2.8	0.4 0.4	- 5.4	- 5.0
3	2.7	6.7	10.4	0.147	0.055	30	21.3	243	0.145	0.066	2.6	↙	3.3 3.2	0.5 0.5	8.3 8.3	8.0 8.0
4	2.5	8.3	7.2	0.157	0.054	30	20.3	233	0.135	0.064	3.1	↓	4.3 4.3	0.6 0.6	9.1 9.1	8.6 8.3
5	6.9	3.8	60.0	0.279	0.213	45	16.2	207	0.061	0.052	17.8	↓	14.7 14.9	3.2 3.2	26.8 23.5	22.2 22.2

1) Absorbance at 450 nm and 400 nm resp. (1g/1 x cm).

2) Duplicates.

Table VIII

Colour of deodorized palm oil compared to oxidation values measured in benzidine values.

Number of samples	Benzidine value		Colour <sup>1)</sup>	
	Range	Mean	Mean	s
9	2.5 - 5.0	3.8	25.11	3.333
23	5.1 - 7.5	6.3	29.70	4.855
28	7.6 - 10.0	8.8	33.10	7.514
23	10.1 - 12.5	11.3	40.85	7.037
6	12.6 - 16.0	14.3	46.17	12.481

1) Lovibond (5 1/4") : Yellow + 10 x Red.

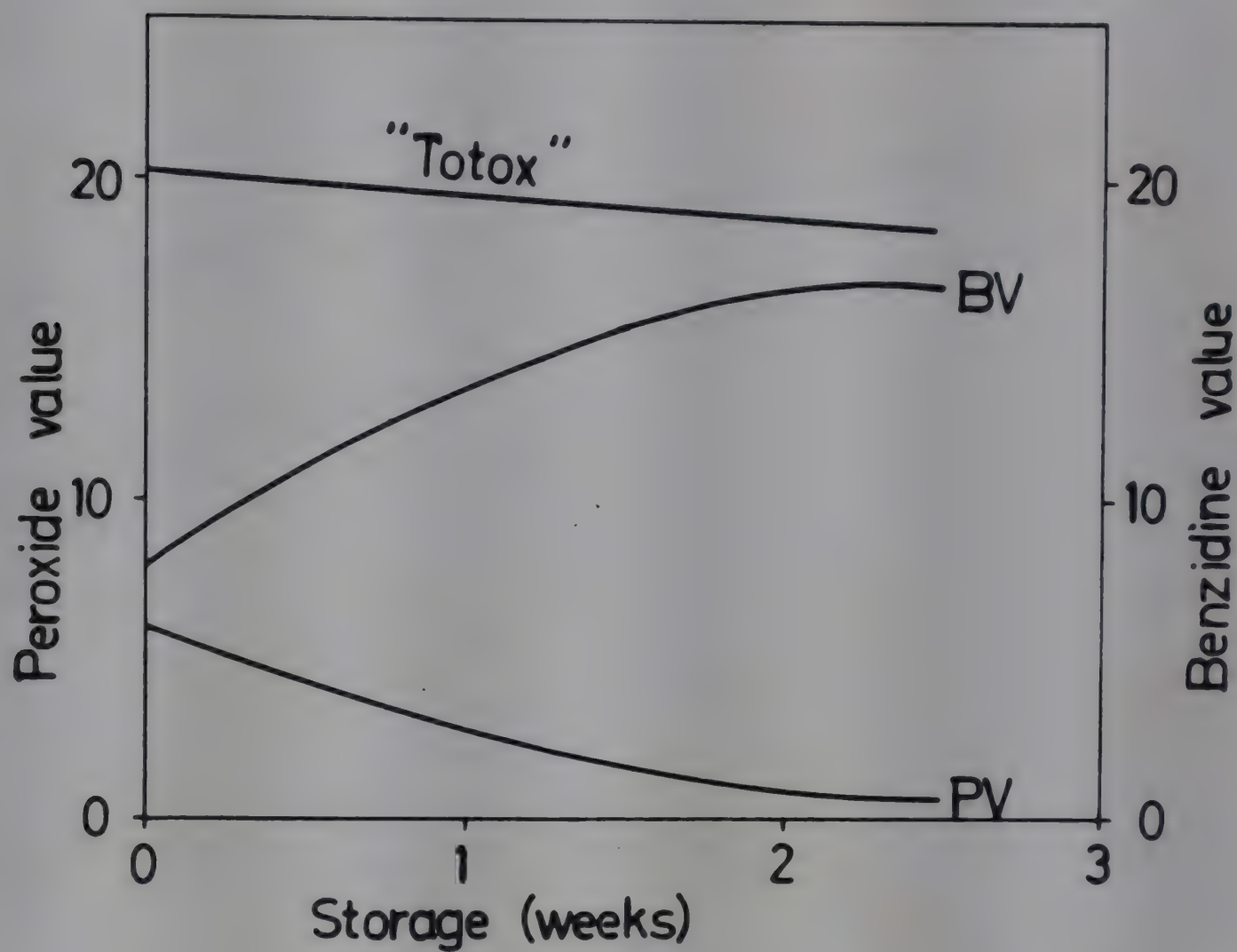


Fig. 1 Storage of crude palm oil at 60°C in the absence of air (sealed ampule). Relationship between peroxide value and benzidine value.

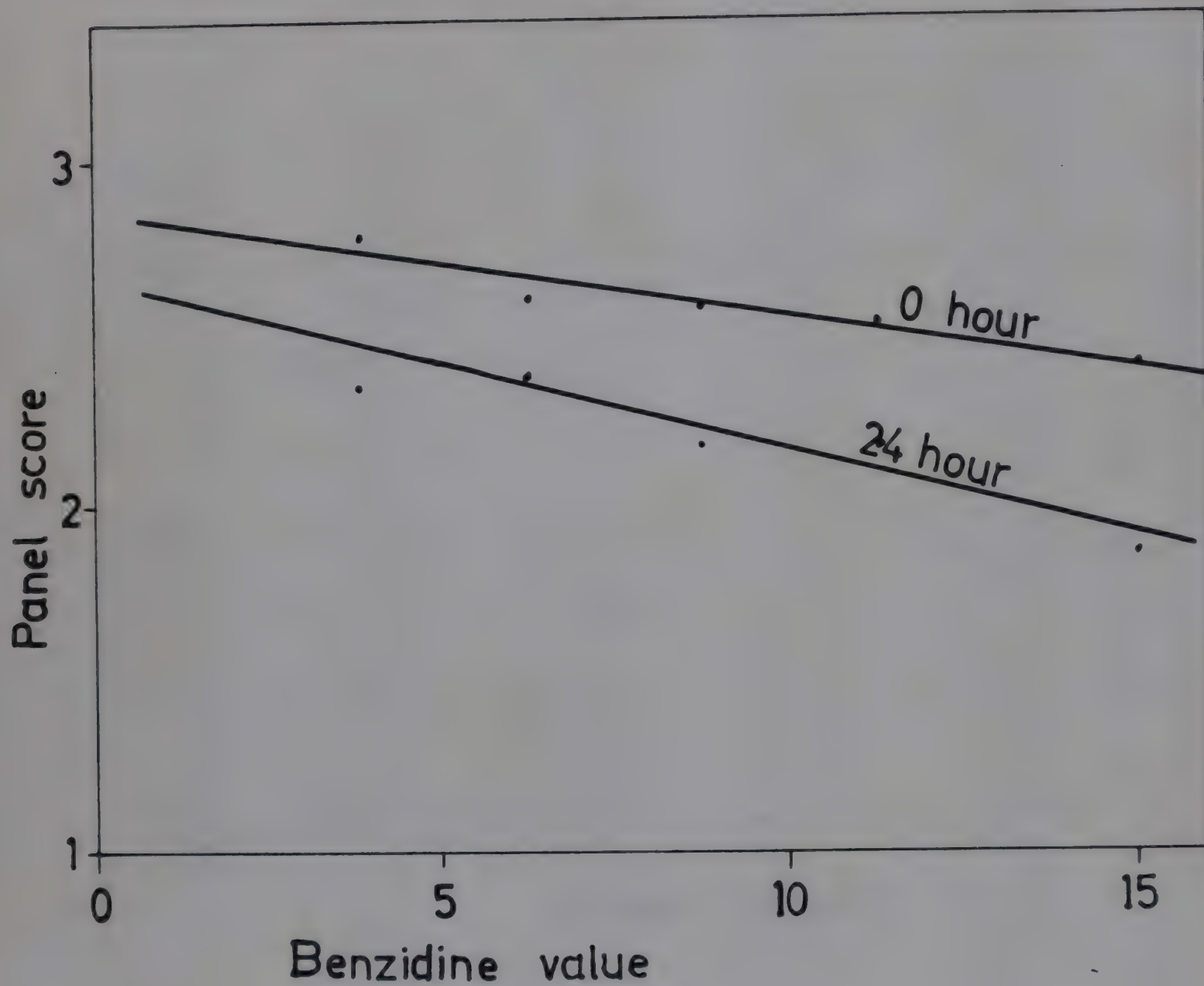


Fig. 2 Taste panel scores of deodorized palm oil at 0 and 24 hours in relation to benzidine values.

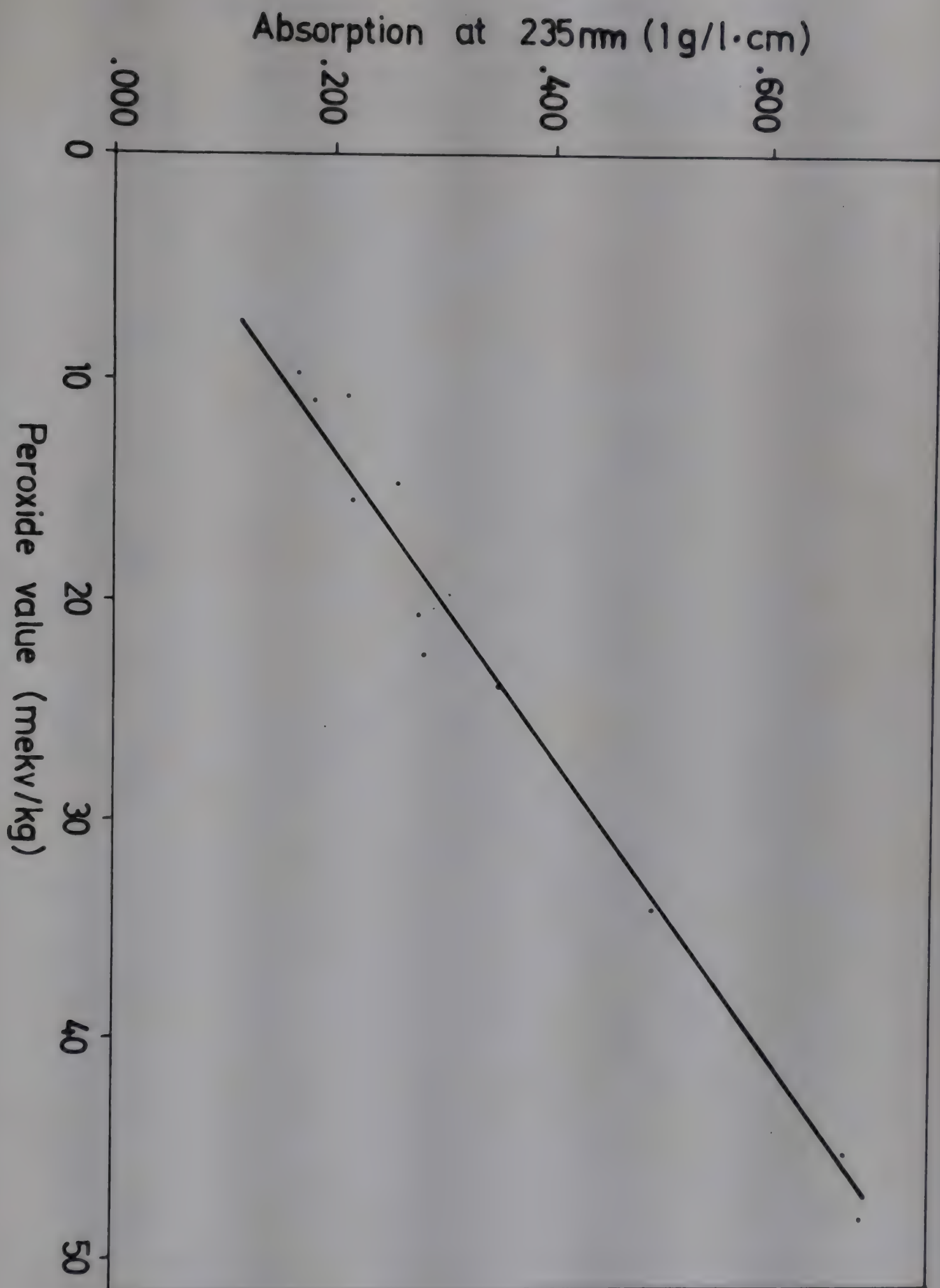


Fig. 3 Relationship between peroxide value/ $a_{235}$  (3.1) and benzidine value/ $a_{270}$  (3.2) in crude palm oil during storage for 12 weeks at 60°C.

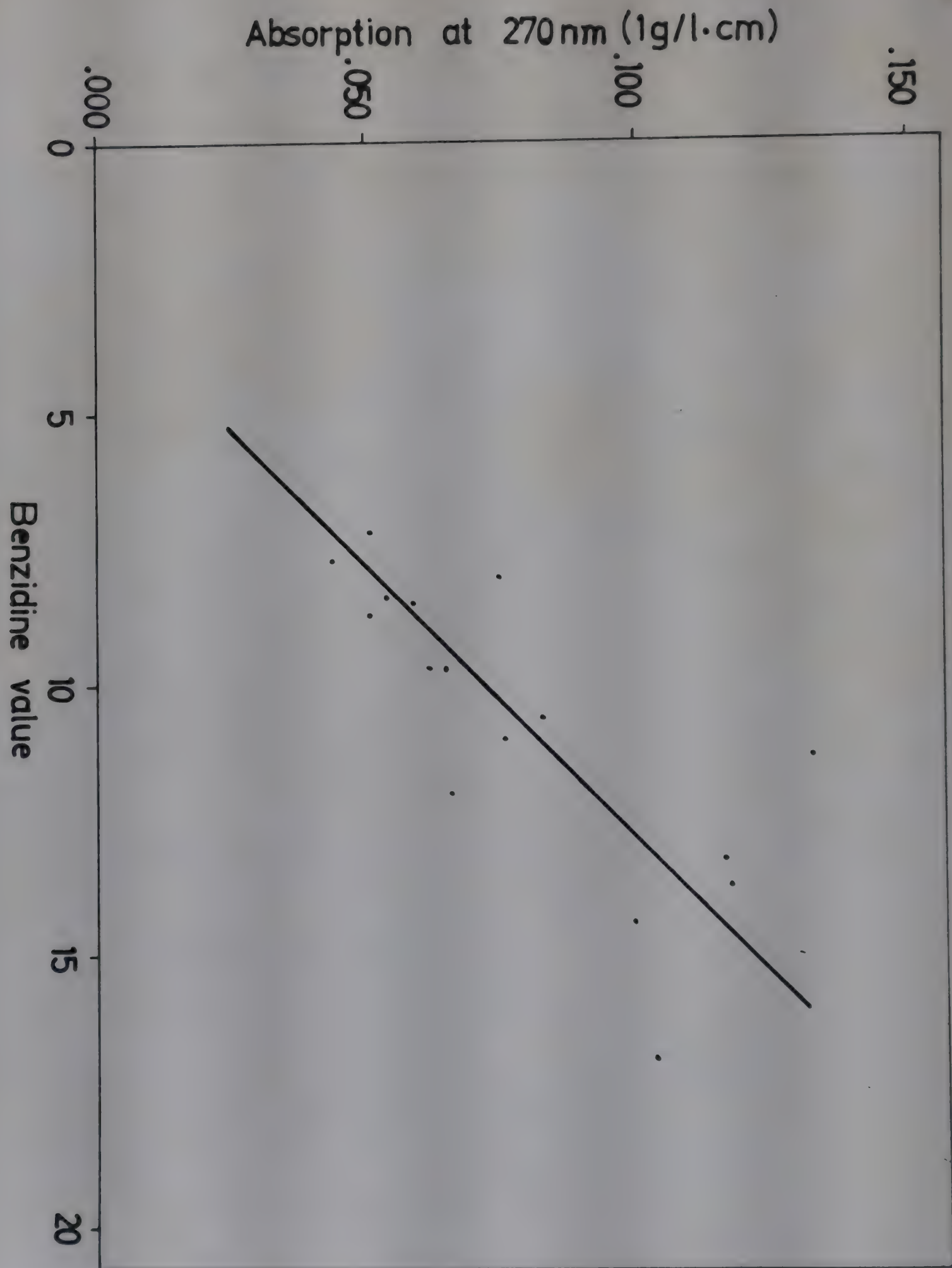


Fig. 3 Relationship between peroxide value/ $a_{235}$  (3.1) and benzidine value/ $a_{270}$  (3.2) in crude palm oil during storage for 12 weeks at 60°C.

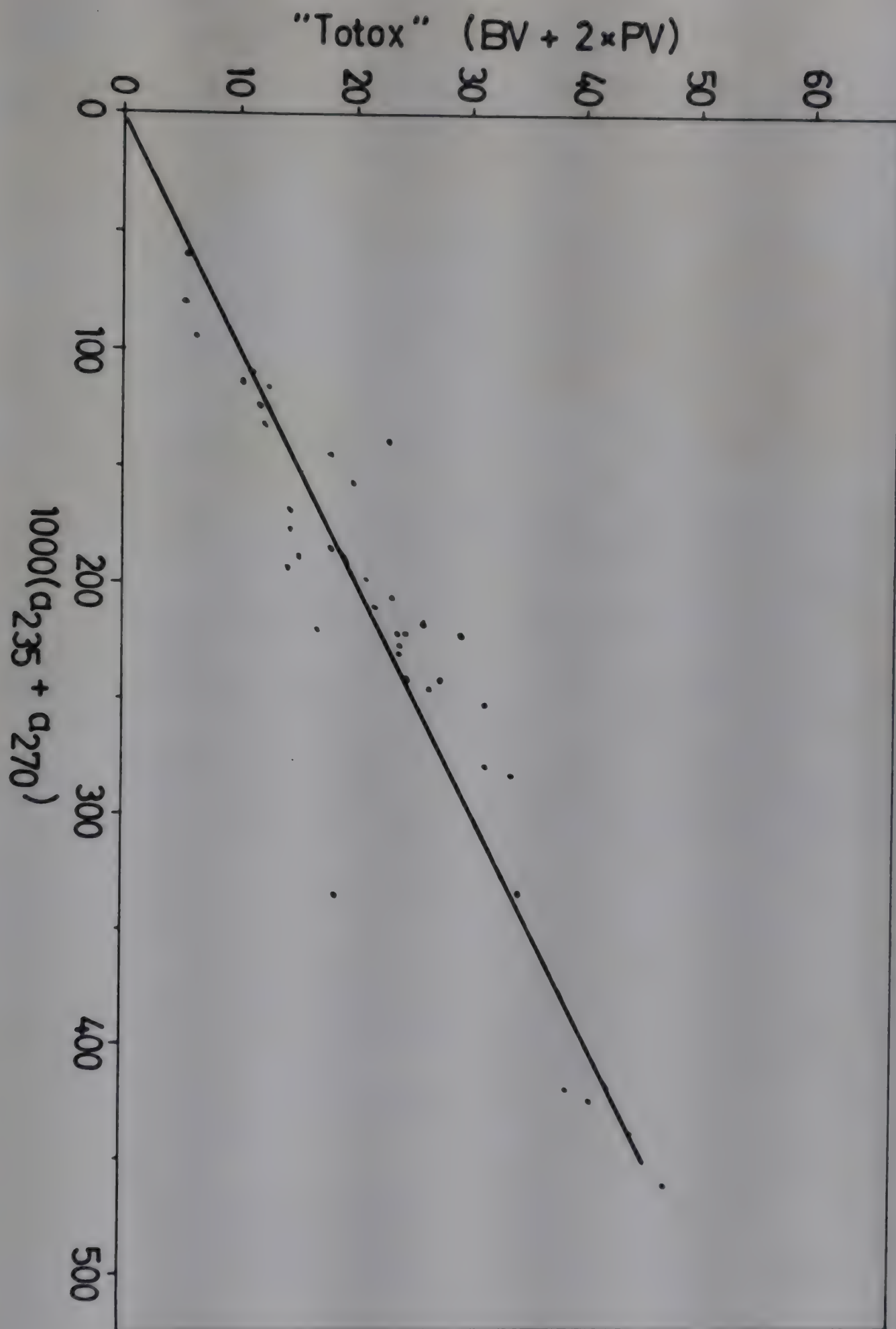


Fig. 4 Relationship between "TOTOX" (BV + 2 PV) and  $1000(a_{235} + a_{270})$  for about 40 different crude palm oils.

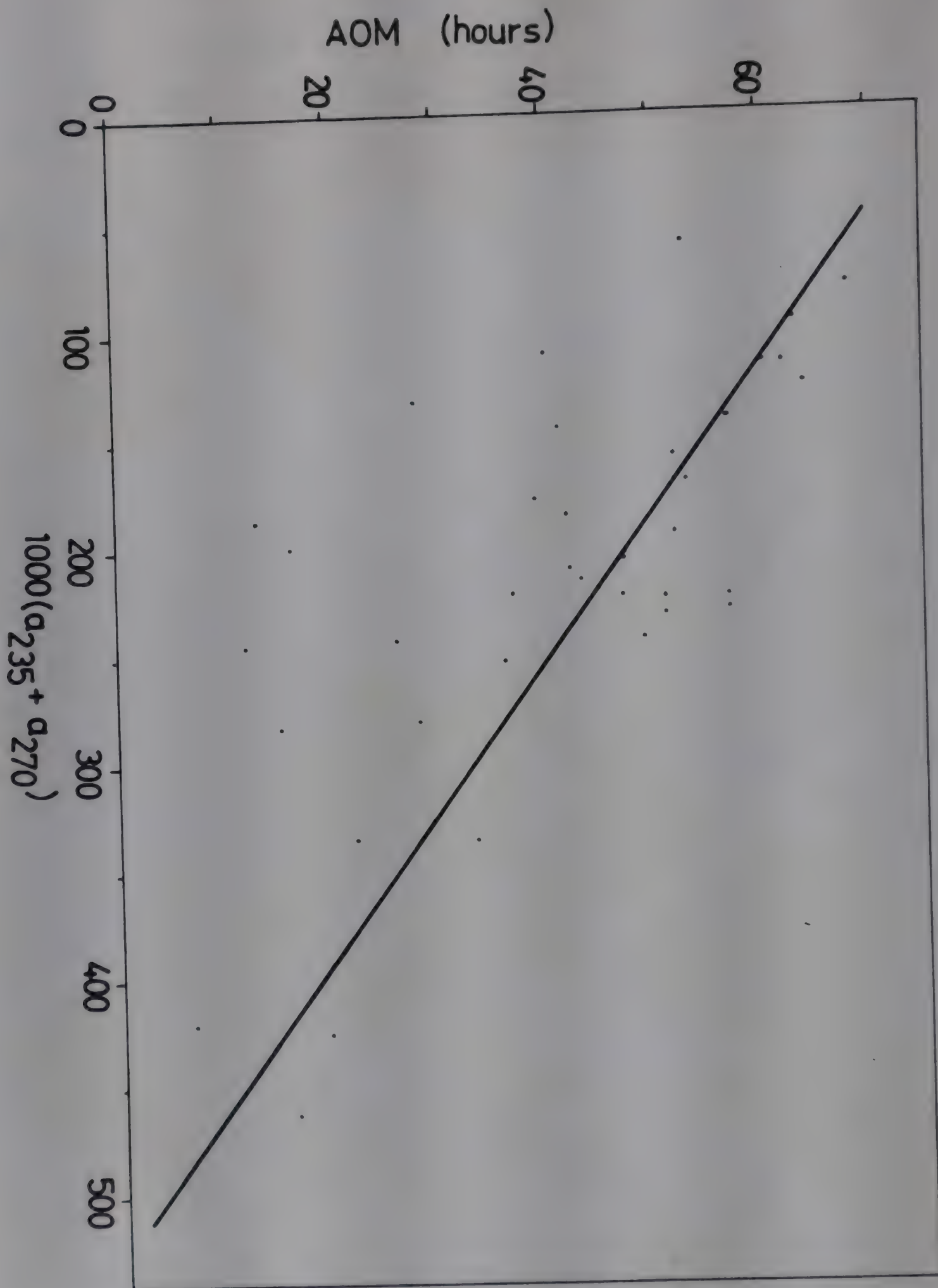


Fig. 5 Relationship between AOM and  $1000(a_{235} + a_{270})$  for the same crude palm oils as in fig. 4.

## Note on the determination of the ultraviolet absorbance of oils and fats

<u>Background.</u>	Oxidative deterioration of oils and fats is accompanied by an increase in the ultraviolet absorption. Determination of the absorption intensity therefore permits the characterization and prediction of the quality of the oil in a broad sense,
<u>Principles.</u>	The absorbance is determined at two different wave lengths around 235 nm <sup>(1)</sup> and 270 nm <sup>(2)</sup> . The absorption curve is recorded between 200 - 350 nm. In order to compensate for the background absorption by the esters (glycerides) a suitable glyceride is used as a reference.
<u>Application.</u>	The determination is generally applicable to all fats and oils, crude and refined.
<u>Apparatus.</u>	Recording double beam spectrophotometer covering the 200-350 nm range Matched quartz cuvettes.
<u>Solvent.</u>	Iso-octane, ACS or equivalent quality. The solvent is spectrophotometrically controlled. It should be transparent in the wave length range of interest [absorption < .01 (1 cm) compared to water].
<u>Reference.</u>	Glyceryl - tripalmitic acid ester or other suitable glyceride. Absorbance must not exceed .05 (1g l <sup>-1</sup> cm <sup>-1</sup> ) at 220 nm and .01 at 300 nm.
<u>Performance.</u>	An appropriate amount of sample is accurately weighed and diluted with the solvent. The concentration is adjusted so as to give an absorbance in the range of .4 - .8. A standardized concentration may be set to 30 mg/10 ml. The reference is prepared in the same way. The absorption of the sample is registered between 350 nm - 200 nm against the reference. The absorbance (a) is then calculated from the absorption (A).

$$a_{235} \quad (\text{lg l}^{-1} \text{cm}^{-1}) = \frac{A_{.235}}{b \cdot c}$$

$$a_{270} \quad (\text{lg l}^{-1} \text{cm}^{-1}) = \frac{A_{.270}}{b \cdot c}$$

b = thickness of cuvette (cm)

c = concentration (g/l)

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1) Conjugated diene region

2) Conjugated triene region

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## THE TREATMENT AND DISPOSAL OF PALM OIL MILL EFFLUENT

(A Summary of Notes by J J Olie and T D Tjeng, Stork, Amsterdam, N.V. Boorstraat - 1, Amsterdam. Fuller information can be obtained from the authors).

The notes review the nature and quantities of palm oil mill effluent to be expected in the near future and consider the magnitude of the disposal problem. Effluent is produced mainly from three different points in the mill, namely, the sterilizers, the sludge separators and from the clay bath-separators or hydrocyclones used in the separation of the palm kernels from the shells. The effluent arising from the sterilizer condensate amounts to approximately 175 kg per ton of fresh fruit bunches (FFB), that from the sludge separators between 250 and 325 kg per ton of FFB and from the clay bath separators or hydrocyclones, approximately 140 kg per ton of FFB.

The effluent from clay bath-separators or hydrocyclones can possibly be discharged directly into local sewers together with domestic sewage water from employees' and labourers' houses as this is considerably less noxious than the effluents from the other two sources. At an estimated Malaysian production of 1 million tons of palm oil per annum in 1975, the quantity of FFB to be processed will approximately amount to 5 million tons per year giving an effluent of about 2.25 million tons per annum. For a typical palm oil mill with a capacity of 20 tons of FFB per hour and milling 22 hours per day, the quantity of effluent to be disposed of per working day is approximately 200 tons, containing about 1.1 tons of oil and about 9 tons of dissolved and suspended solids. Palm oil mill effluent is very highly polluting; it is characterised by an extremely high BOD (biochemical oxygen demand) at 20°C for 5 days of about 20,000 ppm, which is approximately 100 times higher than that of raw sewage and contains a high content of dissolved and suspended solids, mainly organic in nature.

Possible methods of treatment of mill effluent discussed include (1) discharge into the sea, (2) direct discharge into a large, swift-flowing river, (3) biological (aerobic and anaerobic) treatment and (4) de-watering of effluent, followed by drying/incineration. The authors conclude that the first two methods may be satisfactory under certain circumstances but the direct discharge of untreated palm oil effluent into a river in Malaysia will probably affect the quality of the river water very adversely. Considering (3), the aerobic and anaerobic biological treatment methods, the authors conclude that both these would be impractical and the costs prohibitive for a palm oil mill. Various methods of effluent dewatering (4) are reviewed:

- a. Effluent de-watering by soil filtration;
- b. effluent de-watering by vacuum filtration or centrifugation; and
- c. effluent de-watering by evaporation.

a. Effluent de-watering by soil filtration involves pumping the effluent to specially prepared settling fields where filtration by the soil takes place. This is only feasible where there is very good permeability of the soil, a favourable topographical situation of the settling fields with respect to the neighbouring areas, and a river exists in the neighbourhood into which the water filtered by the soil can find its way. The authors state that since palm oil mill effluent is somewhat acidic in nature it would be advisable to neutralise it before pumping into the settling fields. They calculate that the acreage needed for an effluent of 200 tons per day would be about 1 hectare (2.5 acre). They conclude that the settling field may provide an economic method of effluent disposal where suitable land of sufficient area is available at a low land cost.

b. After considering in some detail the possibility of effluent de-watering by vacuum filtration or centrifugation, the authors conclude that at the present state of knowledge, mechanical purification of palm oil mill effluent by such means cannot be recommended.

c. De-watering by multiple effect evaporation followed by drying is frequently used as a method of treating liquid wastes from fermentation industries. The authors, however conclude that this is not to be recommended as a method for treatment of palm oil mill effluent where there is no water conservancy problem. De-watering by evaporation in an evaporation pond is then considered. The authors suggest that where no water conservancy problem exists that this latter method of de-watering be followed, whereby advantage taken of the relatively high temperature of the effluent. The proposed method is somewhat analogous to the process reported by Scholz and Sutter ("Erzeugung von Humusdünger aus dem Abwasser einer Schweinemasterei", 7th International Congress on Agricultural Technology, Baden-Baden, 9 October 1969). After de-watering, the sludge is dried in a rotary drying kiln to a solid product which can be utilized as a humus fertilizer or as fuel for steam boilers, whilst, according to Kirat Singh and Ng Siew Hoong, even its eventual use as animal feed seems worth exploring.

(The Malaysian Agricultural Journal, 1968, 46, 316-323)

The process involves sprinkling incoming palm oil mill effluent onto the surface of the evaporation pond through a distribution piping system provided with up-spray nozzles. Another piping system, also with up-spray sprinklers, is provided for re-circulating the water out of the pond and back into it, in order to enlarge the evaporating surface. For promoting the rate of evaporation, fans could be installed at the site of a pond for blowing air horizontally across the pond. Steam pipes in the pond could also be considered for increasing the water temperature, or the spent gasses from the drying kiln could be conducted into the effluent. Due to the sprinkler system of water sprays and agitation of the pond surface, the authors conclude that the water surface subjected to evaporation into the air will be at least 50 times the surface of the pond. At an effluent temperature of 60°C and an air temperature of 27.5°C with a relative humidity of 85% from data published by Scholz and Sutter (*loc. cit.* above) the rate of evaporation is estimated at 400 litres of water per day per square metre of evaporating pond surface. To reduce 200 tons per day of effluent with a dry matter content of 5% to a concentrate of 20% dry matter content, the authors calculate that the evaporation pond must have surface of 375 sq. m. They suggest that the bottom of the pond be made sloping with the concentrated sludge to be discharged from its deepest point and they anticipate that at a concentration of 20 per cent dry matter, the sludge can still be discharged by pumps. The authors believe that the above method for the treatment and disposal of palm oil mill effluent will probably provide a satisfactory and economical solution to the problem of palm oil mill effluent disposal.

# COLD OIL EXTRACTION IN OIL PALM BUNCH ANALYSIS

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## Abstract

The use of cold solvent to extract oil from the dried and pounded mesocarp of the oil palm has been investigated. Eight changes of petroleum spirit at ambient temperature over a period of 4 days remove 99.5% of the oil extractable by the same solvent during 8 hours at 60°C. The cold solvent method is very cheap in running cost and initial expenditure.

## Introduction

One of the essential analyses in investigating bunch quality of the oil palm is the determination of oil in the mesocarp of the fruit.

Various methods are in use or have been used. Vanderweyen and others (1947) found that the fibre content in the mesocarp was almost constant, so by drying the mesocarp a fairly good estimate could be made of the amount of oil present. This method is easy and cheap, but for breeding and selection work it has not proved sufficiently accurate. Pronounced differences between progenies in fibre to mesocarp have been reported by Blaak and co-workers (1963).

However, in studies concerning bunch quality in agronomic experiments the indirect method of oil determination can still be of value as such experiments are frequently planted with a mixture of seed.

Another more precise indirect method of oil determination is possible with the "Oleometre". (Servant and Henry, 1963). Dried mesocarp is macerated at high speed in dichlorobenzene. The solvent which has a high specific gravity decreases in density with increasing amounts of oil and the specific gravity of the mixture indicates the percentage oil in the sample. Disadvantages of the "Oleometre" are the relatively high costs of the instrument, the high cost of the solvent and the limited throughput. Only about 50 samples can be processed with one "Oleometre" in a normal working day.

The most precise method is the soxhlet extraction of the minced or pounded dried mesocarp with petroleum spirit. This method is accurate and fairly fast, and is currently used by most oil palm research stations and mill laboratories.

In the Research Department of Plantations Pamol du Cameroun the oil determinations have always been done by soxhlet extraction, all the mesocarp of a 100 or 200 g. fruit sample being extracted in a soxhlet handling 26 samples at a time (sample size depending on fruit size, a minimum of 12 fruits being used). However, when the bunch analysis programme was expanded and it became necessary to carry out 80-100 analyses per day this method was considered too expensive as the capital cost of the equipment would have been in the order of £3,000-£3,500.

Cold solvent extraction was tried in an attempt to develop a simpler and cheaper method, which would require a smaller initial investment and less electric power as well as reducing losses in solvent and increasing the number of samples that could be processed.

## A COMPARISON BETWEEN COLD EXTRACTION AND THE SOXHLET METHOD

### Methods and Materials

Dried mesocarp of 100 g fruit samples of 1 tenera and 2 dura palm bunches was pounded and extracted in Whatman thimbles measuring 43 x 123 mm. Changes with petroleum spirit 60-80 were made at 6 a.m., 12 noon and 5 p.m. All determinations were carried out in triplicate.

### Results

Table 1. Percentage oil in fresh oil palm mesocarp. A comparison between cold extraction and the standard method of 8 hours soxhlet extraction. Means of 3 determinations.

Period of Extraction	No. of changes of solvent	Palm Number		
		2/2903 tenera	2/7922 dura	2/2827 dura
24 hours	3	53.0 $\pm$ 0.29	50.0 $\pm$ 2.36	49.0 $\pm$ 0.46
48 hours	6	55.4 $\pm$ 0.63	55.6 $\pm$ 0.63	49.1 $\pm$ 0.75
72 hours	9	54.7 $\pm$ 0.81	55.6 $\pm$ 1.33	50.3 $\pm$ 0.35
96 hours	12	55.5 $\pm$ 0.92	58.2 $\pm$ 0.81	51.6 $\pm$ 1.04
8 hours	Soxhlet Method	56.1 $\pm$ 0.63	57.4 $\pm$ 0.63	49.2 $\pm$ 0.52

The results of the cold solvent extraction are presented in table 1. Under the condition of this trial averaged over the 3 palms, there was no significant difference between methods.

Cold solvent (96 hours) 55.1% oil to fresh mesocarp

Soxhlet ( 8 hours) 54.1% oil to fresh mesocarp

Difference 1.0% non significant

The differences between palms were highly significant. The inter-action between palms and methods was not significant.

### STEPWISE USE OF COLD SOLVENT

Large quantities of solvent (about 120 litres per day) have to be re-distilled when using pure petroleum spirit with the cold solvent extraction. To reduce the re-distillation work a test was carried out in which the solvent from the most extracted samples was transferred to the less extracted samples.

## Methods and materials

The mesocarp from fruits of a single bunch was removed and divided into 64 samples, each of about 50 water free mesocarp. The dried and pounded mesocarp was placed in 43 x 123 mm Whatman extraction thimbles. About 70 of these thimbles fit in a 5 gallon polythene container placed flat on its side. The polythene containers used were formic acid "Jerrycans" from a rubber factory. A hole of 10 cm diameter was cut in the top to allow changing of samples. The solvent used was 60-80 petroleum spirit, bicycle valves were fitted to the bottom of the containers to allow drainage, and the three containers were all connected to a four-way tap by means of "Teflon" tubing. The solvent plus extracted oil was transferred from the most extracted to the container with the less extracted samples by gravity. This is simply done by placing the container on a second shelf 45 cm above the first. The oil and solvent from the least extracted container in the series is drained and the solvent recovered by distillation. The layout is shown in figure 1.

After every change of solvent, at 7 a.m. and 5 p.m., 4 samples were taken out and the amount of oil extracted up to that time was determined. The process was continued for 5 days, that is until 10 changes of solvent had taken place.

## Results

The mean values for amounts of oil extracted after each change of solvent were used to calculate a 'Mitscherlich' type of asymptotic regression curve.

$$Y = 75.1 - 69.5 e^{-1.31x}$$

where Y = (%) oil in dried mesocarp

and x = extraction time in days

It should be kept in mind that this equation is relevant only to the data presented and is not a general formula.

The results are illustrated graphically in Figure 2.

---

Figure 2

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It may be seen that after 4 days and 8 changes of solvent 99.5% of the predicted total oil has been extracted.

In table 3 extraction of well pounded, partially pounded and unpounded dried mesocarp is compared.

Table 3. Percentage oil in dried mesocarp.  
Cold extraction with petroleum ether of dried oil palm mesocarp. All samples are from the same bunch.

Extractions	Well Pounded Mesocarp	Partially Pounded Mesocarp	Unpounded Mesocarp
2	55.8 $\pm$ 0.9	52.0 $\pm$ 2.4	17.1 $\pm$ 3.0
4	71.2 $\pm$ 1.5	66.1 $\pm$ 0.4	44.4 $\pm$ 0.6
8	74.2 $\pm$ 0.6	74.1 $\pm$ 0.7	57.3 $\pm$ 1.8

### Discussion

The cold extraction method has now been employed as a routine method on over 9,000 samples.

On the basis of 8 extractions the method under-estimates oil/bunch by not more than 0.2%. The average difference between cold solvent extraction and the standard soxhlet method over all the samples for which comparative data are available, has been only 0.3% oil/bunch. What proportion of this 0.3% represents waxes and lecithins with a low solubility in cold petroleum ether has not been determined.

In the breeding programme the main interest is in differences between progenies and in differences between palms within progenies. For this purpose the method is sufficiently accurate and any bias will be in the direction of under-estimation. Incomplete pounding, does not affect the final result very much, although extraction is somewhat slower. However, unpounded mesocarp cannot be properly extracted in 8 runs.

When employing cold solvent it is important not to rush the process. One should take 4 days to complete an extraction in order to allow time for the slower diffusion at ambient temperature. Also, it is important to drain the container with the samples for not less than 10 minutes before refilling.

One labourer can prepare 50 samples per day. Including time involved in weighings, pounding, and setting up the equipment, less than 0.03 mandays per oil analysis are needed. The equipment required to deal with a capacity of 100 samples a day is some tubing, four-way taps, condensers and polythene containers, costing, in all, about £20. Any oven or hot plate can be adapted for overnight redistillation; or, if preferred, a continuous redistillation apparatus operating on a water bath could be set up at a cost of about £30.

### Recovery of Petroleum Spirit

An old 1.8 kw giant soxhlet has been adapted for continuous separation of the (oil + petroleum-spirit) mixture. The mixture is fed into the heated reservoir at the rate of 12 litres per hour and the solvent is recovered by continuous drainage of the soxhlet head.

Recovery is 96% taken over a run of 200 litres of used solvent and oil. The loss of 4% is due to the inability to redistil all solvent from the palm oil residue at 100° Centigrade (2.5%), and evaporation in handling and leakage through seals (1.5%). A considerable amount of solvent is retained in the extracted mesocarp in the thimbles after drainage. This solvent is recovered after completion of the 8 extractions by placing the samples in a gas tight container in a hot oven. The solvent is collected by distillation. Five to 5½ litres petroleum spirit are recovered per 70 samples extracted. When the petroleum spirit is recovered from the extracted samples overall losses in solvent are very small.

#### Acknowledgements

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The author acknowledges the permission of Plantations Group of Unilever Limited to publish the results presented in this article.

(French Version in Oléagineux 1970, 25 (3) 165-168. Reproduced here in English by permission).

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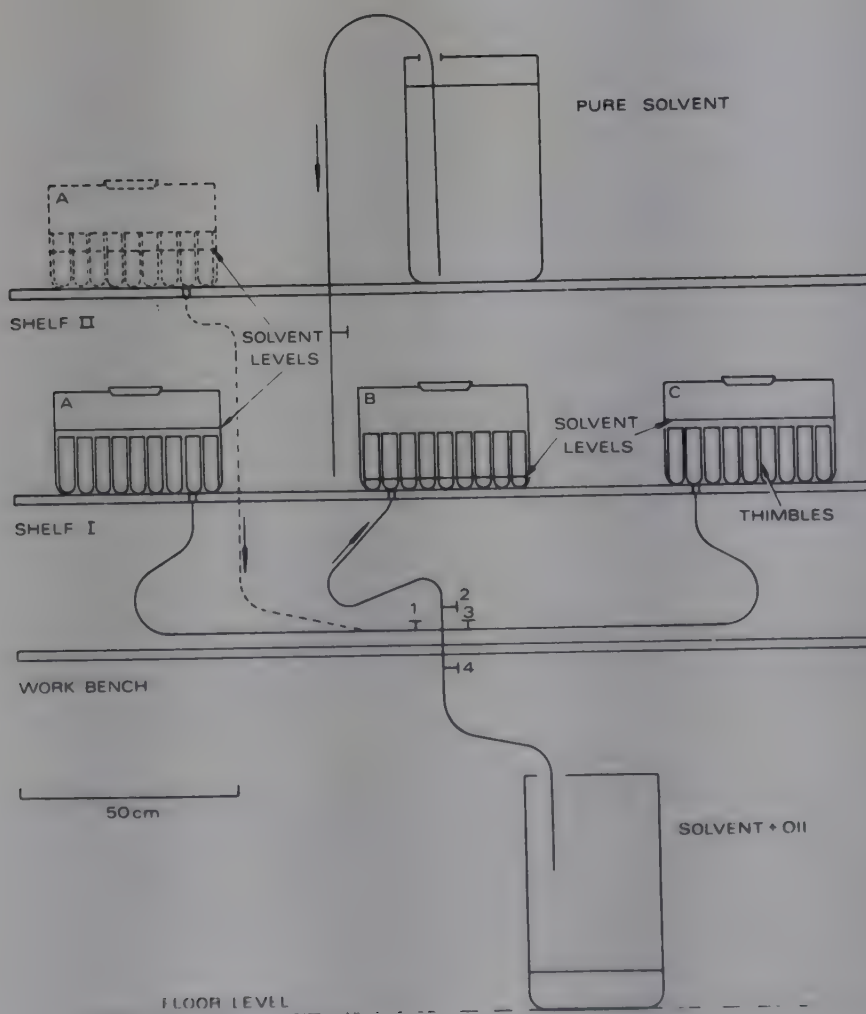


Figure 1. Arrangement of equipment for cold solvent extraction. In the diagram, 'A' on shelf II empties by opening tap 1 and 2, while keeping tap 3 and 4 closed. C could be drained by closing tap 1 and 2 and opening tap 3 and 4.

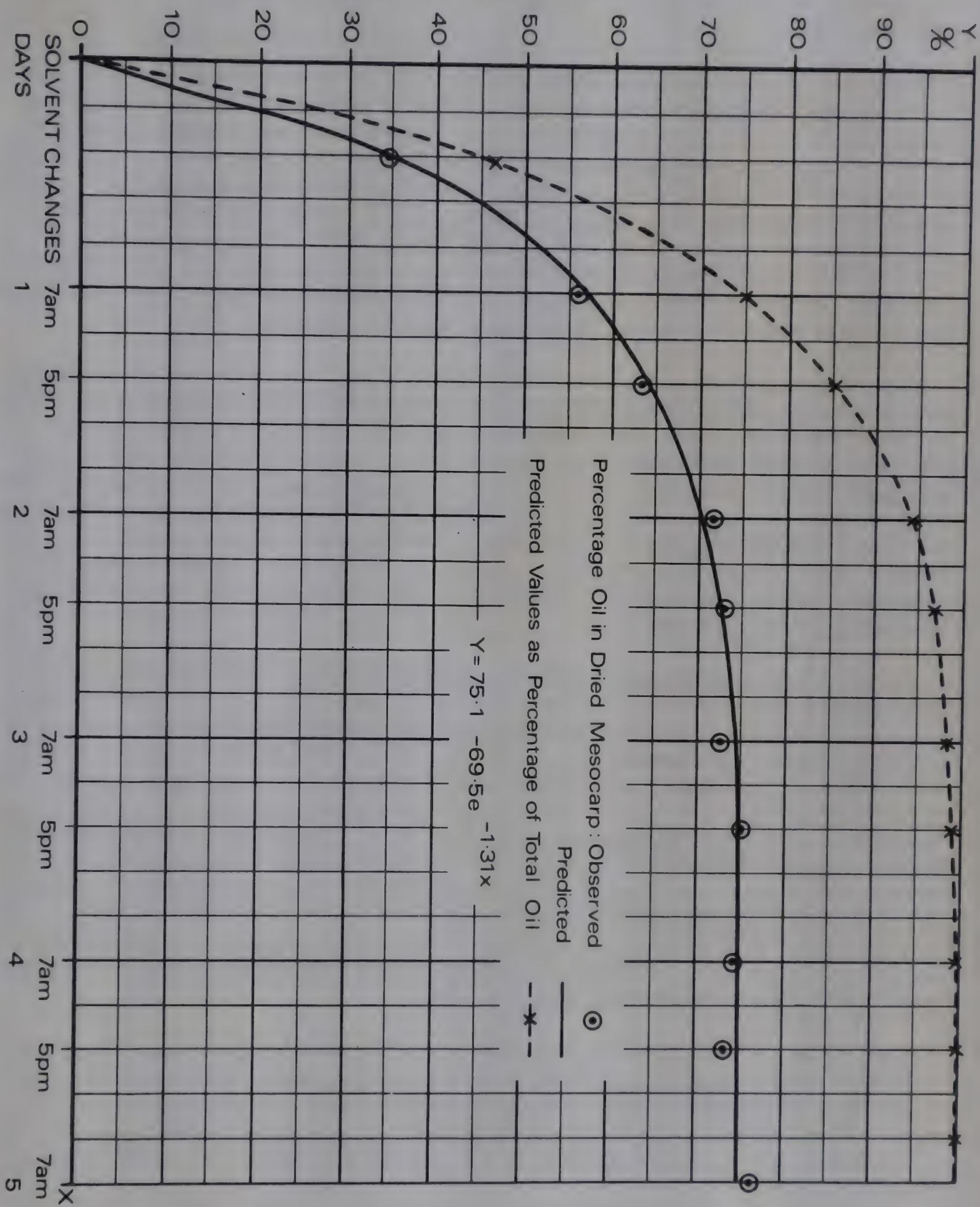


Fig. 2. Cold Solvent extraction of Oil from Dried Mesocarp.

## OIL PALM MARKET SURVEY - A REPORT BY THE COMMONWEALTH SECRETARIAT

The sharply rising movements in edible oil prices during 1970 to the highest levels since the Korean War enabled the increased volume of world palm oil production to be sold on world markets at extremely favourable prices; the annual average price of Malayan oil in 1970 of £110 per ton was 44 per cent higher than the 1969 average of nearly £77 per ton. Starting at £108 per ton in January, values reached peaks of £118 in May and June. Although they subsequently eased in the late summer and autumn, falling to a low point of £95 per ton in September, prices rallied sharply in the closing months of the year to £115 per ton, and continued their advance early in 1971, touching no less than £119 per ton in February. Consumer demand for palm oil in the past year was at a sustained level in the face of shortages of other oils, and shipments were usually sold well forward.

Despite its unusually high price historically, palm oil continued to be a relatively cheap competitor of the edible oils in 1970, while for a substantial part of the year it was also at a discount to fish oil, owing to the restrictions on sales of the latter imposed by the Peruvian authorities which had the effect of keeping up marine oil values. The relative cheapness of palm oil in 1970, when the discount between it and soft oils widened appreciably in many cases, may have been due in part to competition between Malaysian and Sumatran oil. Nevertheless, while there are reasons for believing that palm oil prices might perhaps with advantage have attained even higher levels last year, on the other hand, producers must have received more than adequate returns during 1970, while at the same time enlarging their markets.

Preliminary data for 1970 suggest that world commercial production of palm oil grew by about 100,000 tons to some 970,000 tons. As in the preceding year, the rise in production was apparently almost entirely in Malaysia, with no apparent improvement in Nigeria despite the ending of hostilities, nor, according to incomplete export figures, in Indonesia or the Congo. The larger volume of Malaysian output appears to have been slow in moving on to world markets, according to trade figures, with stocks reportedly increasing in West Malaysia to no less than 48,000 tons at the end of 1970. In fact it appears that Malaysian exports may have been affected by shipping difficulties resulting in the exceptional stock build up indicated by these figures. On the import side, also, the expansion in receipts was slow; true, purchases by the United Kingdom rose from 137,200 tons in 1969 to 159,900 tons in 1970, the highest figure since 1961, but total EEC receipts declined with smaller purchases from the Congo and Indonesia, while United States demand, which had risen in 1969, was reduced fairly sharply in 1970.

The outlook for 1971 points to a further rise in world commercial production of palm oil, which should easily pass the million ton mark for the first time. Once again the major expansion is likely to take place in Malaysia, although smaller producers in Africa and Central America should also partake in the growth. Prospects in Indonesia and the Congo are uncertain, but a limited degree of recovery in Nigerian output and exports might be looked for.

**Commercial Production of Palm Kernel and Palm Oils**  
(Thousand Tons)

	1966	1967	1968	1969	1970 <sup>c</sup>
	oil equivalent <sup>a</sup> (kernels)	oil equivalent <sup>a</sup> (kernels)	oil equivalent <sup>a</sup> (kernels)	oil equivalent <sup>a</sup> (kernels)	oil equivalent <sup>a</sup> (kernels)
<b>Palm kernels</b>					
Nigeria	195	102	89	89	118
Sierra Leone	21	17	25	24	26
West Malaysia	20	23	28	35	40
Angola	8	9	7	7	7
Cameroon	10	10	11	8	8
Congo (Kin.) <sup>b</sup>	38	47	61	52	61
Dahomey	22	19	26	29	27
Indonesia	16	16	18	18	18
Ivory Coast	4	5	5	4	6
Mexico	12	12	12	12	13
Togo	8	6	6	9	8
Other	28	33	35	34	34
<b>Total</b>	<b>382</b>	<b>299</b>	<b>323</b>	<b>321</b>	<b>366</b>
	(814)	(636)	(687)	(683)	(779)
<b>Palm oil</b>					
Nigeria	130	32	4	25	25
East Malaysia (Sabah)	3	9	19	25	27
West Malaysia	183	213	261	321	397
Angola	15	15	12	12	12
Cameroon	17	18	21	23	24
Congo (Kin.) <sup>b</sup>	165	200	240	210	210
Dahomey	10	9	10	14	16
Indonesia	149	171	177	170	170
Ivory Coast	9	12	12	15	17
Others	28	36	48	57	69
<b>Total</b>	<b>709</b>	<b>715</b>	<b>804</b>	<b>872</b>	<b>967</b>

<sup>a</sup> Converted at 47 per cent oil content

<sup>b</sup> Estimates

<sup>c</sup> Provisional; partly estimated

With edible oil and oilseed prices more than likely to maintain an unusually firm tone until the autumn at least, prospects for palm oil values can be considered favourable, even were quotations to fall somewhat below their present high levels. Perhaps a more serious threat to palm oil prices would be a reduction in fish oil values occasioned by a release of the stocks of marine oil currently held by the Peruvian authorities. However, insofar as Peru is likely to endeavour to maintain fish oil prices at as remunerative a level as possible, the dangers from this area of competition should not be over-emphasised.

The boom in edible oil prices during 1970 did not affect lauric oil markets as it did palm oil prices, since the degree of inter-relationship between lauric and edible oil prices is limited. Nevertheless, the exceptionally high prices of edible oils no doubt gave some support to lauric values during 1970, a year when, despite considerable fluctuations, the average level of lauric quotations was well above that of 1969. This partly reflected the fact that the overall increase in lauric oil supplies (i.e. coconut and palm kernel oils together) during 1970 was relatively small, notwithstanding the proportionately larger rise in world palm kernel output. The basic course of palm kernel and oil prices during the year was of rising quotations till April or May, followed by a fairly significant easing in the market during the summer and autumn, ultimately giving way to a strong recovery in the closing months of the year. To some extent this course paralleled the price movement in edible oils, although the weakness in lauric values in the middle of the year was more pronounced and appears to have had its origin mainly in an increased availability of Indonesian and Philippine copra.

The estimate of the fairly large rise in world palm kernel production in 1970, following two years of relative stagnation, is still a somewhat tentative one, since it rests to a certain extent on the assumption that the improved rate of palm kernel purchases in Nigeria in the first nine months of 1970 was fairly well maintained during the rest of the year. Elsewhere significant improvements in output were limited to West Malaysia and probably also the Congo (Kin.), although here, too, certainty is lacking. The available trade statistics for 1970 showed no great change in the combined total of kernels and oil entering world trade, but it should be emphasised that in many cases the coverage of export figures was considerably less than the full year; it appears that the volume of oil moved was slightly greater than in 1969. On the import side United Kingdom receipts of kernels and oil were virtually unchanged in 1970 at 52,000 tons, oil equivalent, but total EEC receipts during the greater part of the year were moderately up, thanks to an increase of a third in oil imports.

# Mid-Month Prices of Palm Oil, Palm Kernels and Palm Kernel Oil

(£ per ton, nearest forward shipment, c.i.f. U.K. ports, excluding duties)

	1969 Average	1970 Average	1970				1971		
			June	Oct.	Nov.	Dec.	Jan.	Feb.	March d
Palm oil, Malayan 5%	76.80 <u>a</u>	110.37	118.00	105.00	115.00	115.00	117.00	119.00	119.00
Palm kernels, Nigeria	64.98 <u>b</u>	70.98	69.00	71.00 <u>c</u>	75.75	76.00	77.00	71.75	69.25
Palm kernel oil, West African	129.58	155.64	152.00	157.00	170.00	173.00	173.00	172.00	152.00

a Average of 10 months only      b Resellers      c Sierra Leone      d On 2nd March

On the production side prospects for palm kernels in 1971 are uncertain, with much depending on the likely level of supplies in Nigeria. Nevertheless, a further modest increase in world production and trade in kernels can probably be looked for, although an expansion in trade is most likely to be in the form of kernel oil, with kernel shipments stagnating or declining somewhat. There has been a revival of interest in kernel crushing in Nigeria, where hitherto processing has been carried out mainly at Ikeja in the Western State. Last year plans were announced for a new mill in Kwara State, and for the installation of processing machinery in the Rivers State; in addition a new mill, with a capacity of some 30,000 tons of kernels, on which work had been started in 1967 but was later interrupted, was due for completion in the East Central State. Pricewise the outlook for 1971 is uncertain; overall a significant improvement in lauric supplies is improbable since the typhoon damage in the Philippines last autumn will check copra output this year. On balance, then, the continued limitations upon lauric supplies, together with the expected firmness of the edible oil market, are likely to keep palm kernel and oil prices at fairly attractive levels. Some marked fluctuations in quotations, as for example the recent fall in palm kernel oil prices, are, however, possible as the result of unexpected but probably temporary selling pressures in the copra market.

## BOOK REVIEWS

EDIBLE OILS AND FATS by Dr Norman E Bednarczyk, Noyes Development Corporation, Park Ridge, New Jersey, USA, 1969 404 pages, 27.5 x 21.5 cms, Price \$35

The Noyes Development Corporation is producing between 1968 and 1971 a series of fifteen Food Processing Reviews based on US Patent literature since 1960. Other titles already published include Dehydration Processes for Food, Protein Supplements, Baked Goods, Confectionery Products, and Alcoholic Malt Beverages. The present volume, No. 5 in the series, deals with the industrial processing and formulation of edible oils to produce margarines, shortenings, flavoured spreads, mayonnaise and emulsified salad dressings, cooking and frying oils, butters, and chocolate products.

Being based on Patent literature, the book represents a comprehensive source of detailed and reliable information for those concerned with production and formulation of foods containing fatty materials.

Industrial processing of fats stems from the fact that natural products only rarely have exactly the characteristics demanded by the consuming public. To take a simple example - a crude vegetable oil is nutritionally a perfectly good source of fat but it usually contains free fatty acids and various oxidation products (giving a soapy or rancid taste), has an unpleasant colour and odour and is cloudy. Refining, an industrial process, is carried out to give the clear, pale, bland product that the public demands. Even the refined deodorised fat will usually be either too hard, or too liquid to be used, on its own, in a margarine and has to be blended with other oils to give the desired physical properties. Addition of antioxidants will often be required to prevent deterioration on storage if it has a polyunsaturated acid content, and emulsifiers are needed to prevent separation into two phases in a mayonnaise or salad cream.

These additives frequently have bizarre chemical names and for this reason I would strongly advise "health food" fanatics to keep well away from this book - his fears that we are being slowly poisoned by "chemicals in our food" will be strongly reinforced. The general populace clearly wants, for instance, a salad oil that will not cloud or produce a solid deposit on standing in the 'fridge'. Addition of a crystallisation inhibitor, namely 3, 3, 5, 5-tetrakis - (hydroxymethyl) - 4 - hydroxytetra-hydropyran esterified with dimerised fatty acid radicals having 28-44 carbon atoms, is found to prevent this happening. A food company has discovered this fact, patents the use, and, who knows, we may now all be consuming 3, 3, 5, 5 tetra ..... by the gram in our salad oil! We clearly have to put our faith in the food companies and the various Government watchdog authorities such as F.D.A. that we are not being poisoned.

Many such instances can be quoted of "desirable properties" of our food that are not imported by the natural constituents and overcoming these deficiencies is, in general, the purpose of Food Technology.

This book is thus a catalogue of attempts by industry to stabilise oil/water emulsions, to prevent the oxidation of the naturally unstable unsaturated fatty acids, to prevent the sticking of foodstuffs to the cooking utensil during frying or baking, to prevent the crystallisation of saturated triglycerides at refrigerator temperatures, to stabilise flavours, to prevent the formation of "bloom" on chocolate, and so on, by the use of additives or special methods of preparation.

The book also provides an interesting mirror of the trends of consumer preference and the efforts of food manufacturers to satisfy them during the '60s. The largest section deals with the production of shortenings, reflecting the increased use by the housewife of cake mixes, ready baked goods and similar cooked or partially cooked and deep-frozen convenience foods. The increased use of interestification, rearrangement, and fractionation in edible oil processing is indicated by the large number of patents employing these techniques. The "health-consciousness" of Americans is apparent from the number of patents (headed "Highly Nutritional Blends"), prompted by the heart disease/serum cholesterol/polyunsaturated fatty acid scare, seeking to increase the polyunsat/sat. ratio in our food fats. The general criticism of hydrogenated fats which contain the un-natural 'trans' isomers of fatty acids is mentioned in several patents. The slimming housewife is also not forgotten and patents for several low-calorie margarines and spreads are described - this briefly means putting more air and water in a fat blend. The water content of margarine leads to obvious difficulties when frying and patents for several "antispattering" agents are included.

228 US Patents in all are covered in the book, the latest being dated March 1969. The speed of publication justifies the decision of the publisher to bind in paper to overcome the consequences of the rapid progress in this field which could soon make the book out of date. Speed of publication can also be blamed, perhaps, for the omission of pages 329 to 344 in the reviewers copy!.

There is a very complete table of contents and three Indices, one for inventor's names, one for the Companies to which patents are assigned, and a third of US Patent numbers. There is no true subject index, making it impossible to quickly locate all patents which involve use of, for instance, a specific antioxidant or a particular vegetable oil.

R.V.H.

## THE QUALITY AND MARKETING OF OIL PALM PRODUCTS.

Edited by P.D. Turner. Proceedings of a Symposium sponsored by the Incorporated Society of Planters. Kuala Lumpur, November 1969, pp. 295. (The Incorporated Society of Planters, P.O. Box 262, Kuala Lumpur, Malaysia). Price to members \$11 and to non members \$15 including postage.

This publication is a collection of the papers, presented at the Palm Oil symposium held in Kuala Lumpur, Malaysia, in November 1969, and is excellently edited by P.D. Turner. The emphasis of the symposium was on the quality and marketing aspects of palm oil and the papers covered various subjects under these headings which included End Use and Field Factors affecting quality. Processing techniques, Storage, Shipping and Marketing. The concern which Malaysian palm oil producers feel for the future of the industry is shown in the variety and quality of the papers presented and provides plenty of encouragement for further research in many aspects of palm oil production and quality. It is most important to find that matters relating to processing are receiving the attention, which has for so long been lacking in past discussions on palm products.

The final review paper by the editor summarizes most effectively the factors affecting the quality of oil palm products, and suggests future investigations and serves as a fitting conclusion to the Proceedings and as a stimulus for future research workers.

E.A.S.

(Reproduced from Trop Sci. 1970, 12 (4))

## RECENT PUBLICATIONS

### Angola

#### CONTROL OF OIL PALM PESTS

(A.H. Rodrigues, Occasional Paper No. 1, Inst. Invest. Agron., Angola 1969, page 15).

Oryctes monoceros. Maintain the plantation free of vegetable refuse. Make ditches a few square meters in area by 80 cm deep and fill with vegetable refuse. After 2 months, then examine them every 3 months and destroy any eggs, larvae, nymphs and adults found.

Rhynchophorus phaeicis. (i) Control Oryctes. (ii) Do not injure the palms during harvesting. (iii) Felled palms are foci for these - destroy the larvae in them. (iv) Give prizes for insects collected.

## Camaroun

### BUNCH ANALYSIS USING COLD SOLVENT EXTRACTION

(G. Blaak, Oléagineux, 1970, 25 (3) 165-168)

[English and Spanish summaries, 3 lines]

The use of cold solvent to extract oil from dried and pounded mesocarp has been investigated. Eight changes of petroleum spirit at ambient temperature over a period of 4 days removed 99.5% of the oil extractable by the same solvents during 8 hours at 60°C. The cold solvent method is very cheap in initial expenditure and running cost. (An English version appears in this issue - Editor).

## Congo

### PATTERNS OF CHANGE IN CONGOLESE AGRICULTURE

(Anon., Foreign Agriculture, 1969, 7 (49) 12)

Agriculture in the Democratic Republic of the Congo is making a slow but steady recovery from the production drop experienced during the 5 years immediately following its independence in 1960. Palm oil, palm kernel oil and palm kernel cake are the Congo's most important agricultural export commodities. Although production has been gradually recovering from 1965 lows, it still remains about 30% below the 1959 level. Palm oil production for 1968 was 175,000 metric tons. For production to reach pre-independent levels of 245,000 tons, new plantings will be necessary. New world prices for palm products for recent years have reduced incentives to increase production and for Congolese to harvest wild fruit. About 80% of production comes from plantations where the crop is collected and marketed by Congopalm, a co-operative for the plantations. An increasing proportion of palm products have been diverted to domestic use in recent years. The Congo is the second largest exporter of palm kernel oil to the United States, usually supplying 30% of total United States imports.

## Ecuador

### OIL PALMS IN ECUADOR

(F. Corrado, Oléagineux, 1970, 25 (4) 197-203)

[English and Spanish summaries, 10 lines]

The oil palm was introduced into Ecuador in 1952 and now covers 5,200 hectares (13,000 acres) made up of plantations of less than 700 hectares, (1,750 acres). Nearly 90% of the plantations lie in the Atlantic region to the west of the Andes in the triangle formed by the towns of Santo Domingo, Quinde and Quevedo, where the ecological factors are, on the whole, suitable for oil palms: the exceptional quality of the soil and a reduced evapotranspiration moderate the depressive effect of low temperatures, poor sunshine and an irregular rainfall distribution. On the other hand, the sector to the east of Guayaquil offers a monsoon climate with a very severe dry season which makes irrigation of the crop indispensable. The behaviour of the palms is very satisfactory in the Santo Domingo region, although it would be advisable to improve techniques with a view to increasing production and getting a better return on investments. In spite of the drive to develop oilseed crops, the internal fats and oils market still presents a marked deficit and the Authorities plan to promote the creation of a further 2,000 to 3,000 hectares of selected palm plantations.

## Ghana

### CERCOSPORIOSIS (*Cercosporia elaeidis*(STEY)

(C. Golato, Revista di Agric. Subtrop. Trop., 1969, 63 (1-3/4-6) 162-163)

This disease attacks the oil palm leaves and shows as rather small spots at first, which become longer, from 4mm at first to 8-10mm and even 14mm in diameter later. The spots are elliptical and dark grey in colour in the centre, and light grey at the edges. The fungus begins to develop on the basal leaves which are the first to be attacked. In the central parts of the spots, fungal frutifications are noted when the disease has completed its development cycle, particularly on the lower surface of its leaves. Control is by means of destruction of the infected leaves. Fungicidal treatment is not recommended. The disease has been observed in all the areas cultivated in Ghana.

## India

### TECHNOLOGY OF OIL PALM OF ANDHRA PRADESH

(T. Obi Reddy and S.D. Thurimala Rao, J. Oil Tech. Association of India, 1969, 1 (1) 18-22)

Various aspects were studied of the technology of African oil palm fruits from the 1967-68 harvest grown in Anakpalli, Andhra Pradesh. The fruit is a dura variety and contains 37-58 per cent pericarp, 38-52 per cent shell, 6-12 per cent kernel. The fruit contains 26-87 per cent palm oil. The oil content of the pericarp varies from 72-84 per cent and that of the kernel from 48 to 50 per cent. It is estimated that 720 kg palm oil per acre would be available.

The extraction efficiencies of oil recovery by different methods tried are (1) boiling the cooked pulp with water, 30 per cent. (2) hydraulic pressing, 70 per cent (3) centrifuging the pulp 80 per cent, and (4) solvent extraction 100 per cent. Palm kernels, on hydraulic pressing gave an oil yield of 40 per cent as against 49 per cent oil content. The physico-chemical properties of palm oil and palm kernel oil obtained compare favourably with those of oil produced in other countries.

### TECHNOLOGY OF OIL PALM OF KERALA

(T. Obi Reddy and S.D. Thurimala Rao, Indian Oil and Soap J., 1969, 35 (5) 107 - 116)

Studies of the fruits of 1968-69 harvest grown in Thodupuzlia, Kerala were undertaken. Oil palm fruit from Kerala is a dura variety. The oil content of the pericarp varies from 67 to 70 per cent on a 17 per cent moisture basis and that of kernel from 46 to 48 per cent on 12 per cent moisture content basis. It is estimated that 1200 kg palm oil per acre would be available.

Centrifuging the cooked and mashed fruit in a perforated basket centrifuge yields 30 per cent oil yield on the whole fruit and 50 per cent oil yield on the weight of pulp, constituting 75 per cent extraction efficiency. Palm kernels on hydraulic pressing give an oil yield of 40 per cent as against 49 per cent oil content. Red coloured palm oils could be directly bleached to a yellow colour by bleaching earth and activated carbon. The physico-chemical properties of palm and palm kernel oils compared favourably with those for these/oils from other countries.

#### OIL PALM - A NATURAL HOST OF ROOT (WILT) DISEASE PATHOGEN OF COCONUT (P. Shanta et al., Current Science, 1970, 39 (11) 260-261)

One year old seedlings of oil palm were planted in the research farm, where the incidence of root (wilt) disease is very high, to observe their reaction to the disease. The seedlings were recently imported to colonise the lace-wing bug (Stephanitis typicus, Dist) the vector of the root (wilt) disease of the coconut. A large number of seedlings began to exhibit pronounced flaccidity of leaflets resembling that of infected coconut palms during the course of this year. The symptoms of flaccidity and dropping of the leaflets in oil palm seedlings together with slight paling, transmission of the virus through S. typicus and the production of diagnostic symptoms on many of the seedlings are indicative of root (wilt) disease of coconuts infecting the oil palm in nature. This is of special significance since it is being introduced as a promising crop in Kerala.

#### Ivory Coast

##### MAINTENANCE OF PALM CIRCLES USING HERBICIDES

(P. Coomans, Oléagineux, 1970, 25 (3) 133-135)  
[English and Spanish summaries, 9 lines]

Experiments have been carried out by IRHO on the use of herbicides for weeding circles, with a view to reducing labour requirements maintenance of adult oil palm plantations. The first results obtained in the Lower Ivory Coast, using different formulae and modes of application, show that it is possible to keep the palm circles clean with 4 sprayings per year with a solution with a Paraquat or sodium arsenite basis. The cost of the treatment is about 85% of that of hand weeding. These applications are carried out by means of a knapsack-type spray at controlled pressure producing a low volume spray at about 180-200 litres solution per hectare (15.8 - 17.6 gallons per acre). The experiments are being continued.

## BUNCH CHARACTERISTICS

(J. Meunier et al, Oléagineux, 1970, 25 (7) 377-381)

[Spanish and English summaries, 10 lines]

The first results from the seed field planted on the IRHO station at La Mé in the Ivory Coast enabled forecasts of inheritance of different characters to be worked out. As far as production is concerned, bunch number seems, in the early years, more inherited than average bunch weight. The percentages of pulp and kernel, and the average fruit weight have shown themselves to be the most inherited of the quality characters. The oil content of the pulp requires closer study.

Again, progeny trials have provided valuable information on the value of the parents and revealed numerous cases where specific combining ability is excellent. Taking account of these data, which may undergo modification with age, it is possible to define, according to each character, the respective importance to be given to inheritance and tests when choosing parents for seed supply and for the search for selections.

## Malaysia

### CHEMARA RESEARCH

(Anon., Communications (Agronomic) Chemera Research Station, Kampulan Guthrie Sdn Bhd, Labu Road, Seremban, W. Malaysia, November 1969)

This communication documents past publications and reports prepared by the Chemara staff. Readers may order photocopies of articles from the Station at a cost of 25 cents (Malaysian) per page. No spare copies of articles are available.

### NEW SYSTEM OF FIELD COLLECTION AND TRANSPORTATION OF BUNCHES

(J. G. M. Price, The Planter, 1970, 45 (529) 115-117)

The collection and transportation of fresh fruit bunches from the field to the oil mill is a major problem in oil palm estate practice, and expenditure on this item is very significant whether the estate is beside the mill or many miles distant. The author describes a new system using nets which has been in satisfactory operation for about 12 months. The main advantages are: it is economically attractive; storage of fruit on nets in the field greatly reduces storage capacity needs on the estate or at the mill. The system is simple to operate, and handling and bruising of fruit is reduced to a minimum. It is very rapid and thus permits a very large tonnage to be collected and delivered in one day by a single lorry. The harvesters collect and stack all bunches and loose fruit on to the loading nets which are very light and easy to distribute and handle.

## PALM OIL - THE GROWING GIANT OF MALAYSIA

(Dale E. Vining, Foreign Agriculture, 1970, 8 (13) 8-9)

The history of the oil palm in Malaysia began in 1870 when the oil palm first entered the country. Commercial plantings, however, were not initiated until 1917 and by the year 1923, the area in oil palm totalled slightly over 1,000 acres. During the 1960's, Malaysia jumped from a small producer and exporter of palm oil to the world's largest, and by 1974, according to Government officials, Malaysia will have nearly 1 million acres devoted to oil palm, more than double the acreage of 1968. Palm oil from this acreage should allow Malaysia to retain its position as one of the world's top producers and largest palm oil exporter.

## THE FOLIAR COMPOSITION OF OIL PALM IN WEST MALAYSIA

(Poon Yew Chin et al. Expt. Agric., 1970, 6 335-339)

In an oil palm uniformity trial in West Malaysia leaf samples were analysed and fruit type was recorded. Significant differences were found in foliar composition according to fruit type and it is suggested that this factor should be taken into account, together with other genotypic differences, in using leaf analysis as a guide to the fertilizer requirements of palms.

## RIPENESS AND OIL SYNTHESIS IN TENERA OIL PALM BUNCHES IN MALAYSIA

(J. A. Rajaratnam and C.N. Williams, The Planter, 1970, 46 (535) 339-341)

Harvesting of oil palm fruits in estate practice, is carried out on a periodical basis with harvesting rounds ranging between three days and fortnightly intervals. The usual criterion for ripeness of a fruit bunch is based in the occurrence of detached fruits on the ground which have fallen from the bunches. In estate practice, ripeness of a bunch is established on the relationship between the number of detached fruits and the estimated bunch weight (as judged by the harvester) and varies according to the management. Most consider 1 or 2 detached fruit per pound bunch weight, others simply consider the number of detached fruit regardless of bunch size and criteria vary from 5 to 20 detached fruits per bunch.

Because the oil yield is closely related to the ripeness, it is important to have information relating the occurrence of detached fruit to the synthesis of oil in the bunch and data on oil synthesis was obtained at two lowland sites in Malaysia.

## West Africa

### SCALE OF OIL PALM FRUIT PROCESSING

(S. La-Anyane, Proceedings on the Second Seminar on Food Sciences and Technology in Ghana, Food Research Institute, Accra, 1969 pages 24-34)

After outlining the state of oil palm production and processing with particular reference to Nigeria and the Congo, the author discusses the relative merits of small scale peasant processing versus large-scale processing by mills in the local context. The choice in Nigeria of processing by hand presses or by Pioneer Oil Mills and of the hand presses, between the cage press and the hydraulic press, is considered in some detail.

Some of the advantages put forward for cage press operation in Nigeria are that the presses are constructed and maintained by the local blacksmith. The farmer is not necessarily interested in obtaining maximum oil extraction but in obtaining enough oil for his subsistence needs in relation to local market prices. Palm fruit fibre containing some oil for use in lighting up the kitchen fires saves the farmer the expense of kerosene. The major factor is that the capital cost of a cage press is of the order of one tenth the cost of a hydraulic hand press.

In the record of the ensuing discussion, the application to the Ghanaian situation is considered and the practicability of a suggestion of an English oil industrialist that a mobile oil-pressing unit be assembled on a vehicle and transported from farm to farm is discussed. It is generally concluded that no single solution is adequate to cover the situation in Ghana.

## General

### OIL PALM NURSERY CONTROL WITH "GRAMOXONE"

(J. K. Kapoor and C. R. Armstrong, The Planter, 1970, 46 (535) 342-346)

With the increasing cultivation of oil palm, more planters are faced with the problem of maintenance in oil palm nurseries. One of these problems is weed control. One of three methods outlined here, the one showing the most promise of being effective, time saving and economical is that using "Gramoxone". This, should be applied at a rate of two pints in 20-40 gallons of water and repeated firstly after three weeks, then after four weeks and subsequently at 25% weed regeneration.

### MECHANISED LAND CLEARING FOR THE CREATION OF INDUSTRIAL PALM PLANTATIONS

(G. Martin, Oléagineux, 1970, 25 (11) 575-580)

[English and Spanish summaries 11 lines]

The complete mechanisation of land clearing enables large annual programmes of oil palm planting to be carried out, and thus ensures the best action on the operation. The most rapid and economic method for standard caterpillar tractors uses a Rome KG stringer blade and takes about three hours to clear one hectare when the total clearing is 300 trees hectare, including two to four subjects more than 150 cm in diameter.

Overvaluation co-efficients are proposed to take into account increases in density, the topography, the soil, etc. Where the annual programmes cover more than 1000 hectares and where an increase in the tractor park is not desirable, the use of a new machine, the "Tree Crusher" could be envisaged.

#### GREATER PRODUCTIVITY OF THE OIL PALM WITH EFFICIENT FERTILISERS

(Ng Sieeo Kee, Oléagineux, 1970, 25 (12) 637-647)

[English and Spanish summaries, 16 lines]

An integrated ecological-physiological approach to assess fertiliser requirements of the oil palm is described. The method includes the factors of crop physiology, soil type and nutrient status, nutrient composition of the palm, fertiliser experiments and leaf analysis.

The results show a continual growth of fertiliser use on oil palms, but the precise quantum of expansion in a particular area depends on climate, soil conditions and standards of agronomic practice.

#### OIL PALM POLLEN, HARVESTING, PREPARATION, CONDITIONING AND USE

(G. Benard and J. M. Noiret, Oléagineux, 1970, 25 (2) 67-73)

[English and Spanish summaries, 12 lines]

The production of selected oil palm seeds by means of artificial pollination requires that the quantity of pollen needed should be available at the right moment. Thus, pollen having a short life, measures must be taken to ensure its preservation: drying to less than 4% humidity, conditioning in flasks in vacuo, and then storage at minus 18 °C. Tests have shown that under these conditions, the pollen keeps well for more than a year. This process not only allows the pollen to keep its germination and fertilising power, but also avoids the formation of abnormal embryos, the incidence of which appears related to a bad state of preservation.

The methods and material used are described in detail: Bagging of the inflorescences, manipulation in hermetic and heat sterilised containers, pollen drying, conditioning, and storage. They offer a guarantee of the genetic purity of the pollen, which is indispensable for obtaining a legitimate progeny, not only for breeding purposes but for industrial plantations.

## ROAD NETWORK PLANNING FOR A PALM OIL ESTATE

(C. Surre and R. Ochs, *Pratique Agricole Consiels de L'IRHO* - 92, Oléagineux, 1970, 25 (2) 75-78)

Good planning of a road network is of great importance in a plantation. Its layout must be studied in order to avoid uneven ground and reduce the establishment and maintenance costs and facilitate the flow of traffic. A network from north to south and east to west is said to be preferred but its planning will not always be possible.

## DISCOLOURATION OF PALM KERNELS IN RELATION TO PROCESSING CONDITIONS

(W. L. Thieme and J. J. Olie, Oléagineux, 1970, 25 (6) 351-354)

The kernels were given different heat treatments to establish the progress of the discolouration in relation to temperature and time, by comparing the colours with a standard. The isotherms were determined every ten degrees from 80°C to 140°C. In semilogarithmic graphs, straight and parallel lines were obtained. However, temperature tests were inconclusive. The chief factor responsible for kernel discolouration is sterilisation. Additional discolouration in the digester is slight, whilst protein discolouration in the nut bin and kernel drier is negligible provided the temperature of the drying air and the retention times of nuts and kernels are normal.

## INBREEDING OF OIL PALMS AND EFFECTS ON SELECTION

(J. J. Hardon, Oléagineux, 1970, 25 (8-9) 449-455)

[French and Spanish summaries, 9 lines]

Slow rates of selection progress within oil palm breeding populations and improvements observed in inter-population crosses can to a large extent be explained by various degrees of inbreeding. There is no evidence that non-additive variance is an important genetic component of yield in the oil palm and under the circumstances it is questioned whether systems of Recurrent Reciprocal Selection (R.R.S.) are suitable design for oil palm breeding. It is suggested that breeding in the oil palm should be directed towards re-establishing genetic variability in the breeding material by new introductions and inter-crossing material of various origins. In such generally more variable populations, mass selection should be carried out on family and individual palm performance. Since no land and facilities are required for planting and recording the test crosses, a larger number of parents can be incorporated in the breeding programme which reduces the change of inbreeding through random loss of genetic variability. Until such time that these new populations are available, reliance must be placed on the inter-population crosses for seed production to avoid inbreeding.

## VARIATION IN LEAF NUTRIENT LEVELS IN RELATION TO SAMPLING INTENSITY (Poon Yew Chin, Experimental Agriculture, 1970, 6 (2) 113-121)

A uniformity trial was carried out at Banting, Selangor in West Malaysia to estimate optimal sampling rates for determining foliar nutrient contents of oil palms. The results suggest that the unit for sampling in this area is greater than 10 acres but less than 50. A comparison of the results with those obtained in Nigeria shows a large measure of agreement. Factors concerned in choosing a sampling rate are discussed. With the information available, a rate of 2-3% appears adequate.

## OIL PALM FOLIAR COMPOSITION

(Poon Yew Chin et al., Experimental Agriculture, 1970, 6 (3) 191-196)

Total and partial correlations are presented between foliar nutrients in a uniformity trial. The method of principal component analysis is applied to the correlation matrices, comparing values for three fronds (3, 9 and 17). The results are also compared with values obtained elsewhere, and the use of principal components in relating yield to foliar composition is illustrated.

## END USES FOR PALM OIL

(Special Session of the Study Group on Oilseeds, Oils and Fats, FAO, CCP/70/4, December 1970)

The Secretariat plans to carry out a study of existing end uses for palm oil and consider the possibilities of developing new ones.

## CHEMICAL WEED CONTROL UNDER YOUNG OIL PALMS

(A. K. Seth, The Planter, 1970, 46 (527)32-36)

In trials on mixed weeds in oil palms, MSMA controlled few weeds other than Paspalum conjugatum. Paraquat possessed a much wider spectrum but P. conjugatum regenerates rapidly following good initial desiccation. Mixtures of either 0.75 pounds per acre Paraquat plus 0.75 pounds per acre Diuron or 0.75 pounds per acre Paraquat plus 0.25 pounds per acre Diuron plus 1.6 pounds per acre MSMA gave lasting control of all the various weed species including P. conjugatum under fully open conditions.

## THE EFFECT OF DRYING PALM NUTS ON CRACKABILITY AND PERCENTAGE ESTIMATE OF SHELL AND KERNEL

(M. Mollegarde, Oléagineux, 1970, 25 (3) 139-143)

[French and Spanish summaries, 6 lines]

This reports the results of measurements taken in Malaysia with the object of finding out the effect of different drying times on:

(i) Nut crackability. (ii) Error in determination of the percentage of kernel to fruit. Thus, drying the nuts at 80 °C for 4 hours which improves crackability, entails an under-estimation of kernel on fruit of 6.0% for dura and 16% for tenera varieties, and equivalent over-estimation in respect of the percentages of shell on fruit.

## ECONOMICS OF MANURING OIL PALMS

(E. C. Paterson Oléagineux, 1970, 25 (5) 255-263)

[English and Spanish summaries, 7 lines]

Figures are presented to show the level of fertiliser usage on West Malaysian estates. A calculation is given on the profitability of an oil palm enterprise at four different field levels to show the relationship between fixed costs and variable inputs, including fertiliser. The case for adequate usage of fertilisers in the immature period is stated and the likelihood of obtaining economic responses to fertilisers on mature palms is examined. Figures from a group of estates are given to illustrate the importance of comparing fertiliser usage and yield levels for similar areas when assessing the adequacy of a fertiliser routine.

## SMALL-SCALE POLLEN COLLECTION AND DRYING

(T. A. T. Leitch, The Planter, 1970, 46 (532) 216-219)

Pollen collection is usually confined to late morning and afternoons when there has been no rain. On hot dry days, the male flowers release the maximum amount of pollen. A pollen harvester's collection averages approximately 30 spathes per day, and the average yield of undried and unsieved pollen is 2.3 pounds per collector per day. After sieving and drying, each collector averages 1.8 pounds per day. These observations are calculated from over 2,600 collector days from September 1968 to March 1970 when 78,343 spathes were dealt with. It is not surprising, but a point which is often forgotten, that people working with pollen frequently develop allergic reactions such as asthmatic complaints, swellings etc. After drying, the pollen is filled into self-sealing plastic bags. Pollen can be stored safely at sub-zero temperatures. The intention in drying and storing has been thus far to augment pollen supplies for short periods of adverse weather. The pollen reserves held in deep freeze storage are withdrawn at regular intervals and fresh supplies added so that on average, no pollen is more than 1 month old. On removal from deep freeze, the pollen is allowed to "breathe" for 12 hours or longer.

Cercospora elaeidis, STEY, AND THE OIL PALM  
(A. D. S. Duff, Oléagineux, 1970, 25 (6) 329-332)  
[English and Spanish summaries, 6 lines]

A brief resumé is given concerning the attempted control of the *Cercospora* disease of the oil palm by the use of fungicides. Even with full technical supervision and regular spray schedules, no real success can be claimed. Reasons are advanced as to why the use of normal protectant fungicides have not, and never will, control this disease. The economic importance of the disease is assessed for the first time and since comparisons cannot be made between "treated" and "untreated" plots, a different approach has been used. The figures presented show that C. elaeidis can cause very serious losses in affected areas.

RELATIONSHIP BETWEEN MESOCARP THICKNESS AND OIL CONTENT OF PALM FRUITS  
(Anon, Nigerian Institute for Oil Palm Research, Quarterly Progress Report No. 72,  
January - March 1970, page 8)

No.	Tenera Palms			Dura Palms		
	Mesocarp Thickness mm	Oil to Fruit	Oil to Bunch	Mesocarp Thickness mm	Oil to Fruit	Oil to Bunch
1	1.99	22.08	16.45	1.63	14.46	9.75
2	2.70	27.05	16.77	1.69	18.32	11.97
3	3.13	32.53	18.78	1.81	24.37	18.52
4	2.21	23.82	18.07	1.44	13.82	8.47
5	2.70	32.25	19.94	1.98	29.61	17.81
6	2.19	27.47	23.05	1.30	15.80	10.96
7	2.58	40.55	25.41	1.70	16.96	11.33
8	3.48	39.33	21.31	1.71	23.24	13.91
9	2.55	34.00	19.22	2.23	24.04	13.40
10	2.48	34.74	20.17	1.46	22.50	13.73
11	2.54	17.83	11.75	1.56	22.36	13.80
12	4.47	61.55	26.83	1.50	55.49	23.43

The data are being analysed

## WILT DISEASE IN THE OIL PALM

(J. L. Renard, Oléagineaux, 1970, 25 (11) 581-586)

[English and Spanish summaries, four lines]

Oil Palm Wilt is a disease which causes considerable damage on the West African plantations. The possible ways of entry of Fusarium oxysporum into the vascular system are studied, particularly underlining the part played by root injuries in the infection process. The rapid progress of the parasite is due mainly to the transmission of the spores in the sap.

## QUALITY ASPECTS OF PALM KERNEL PRODUCTION

(B. Bek - Nielsen, Oléagineaux, 1970, 25 (11) 611-614)

[English and Spanish summaries, seven lines]

The quality of kernel oil is degraded during normal processing, especially that of FFA content. Prolonged storage leads to further reduction; immediate local oil extraction after kernel production could be advantageous. Sterilisation by live steam was shown to reduce quality degradation, and a small sterilising unit could ensure improved quality. Acidity increase of stored oil was less than that of kernels, possibly due to differences in biodeterioration activity. Sterilisation also improved oil colour which would presumably make subsequent bleaching cheaper. A kernel winnowing plant is described to overcome the problem of admixture from processing tenera fruit. This ensures uniform quality and obviates hand sorting.

## TRAINING AND INFORMATION

The Bureau is prepared to advise management in the oil palm industry on the training of personnel. Details of the nationality, linguistic abilities and educational background of the candidate would be needed, together with the purpose for which training is required. Information is available about the funds which can be provided to assist in training and the Bureau can advise on how such assistance may be obtained.

The Tropical Products Institute has one of the world's best libraries of periodicals and works of reference dealing with the products of developing countries and photocopies of articles dealing with the oil palm can be provided on request. Answers to technical queries concerning the oil palm can also be dealt with; certain agronomic or engineering inquiries might have to be referred outside the Institute, but the Secretary of the Bureau would endeavour to find the best source of information.

In general, no charge will be made for any of the services provided but, if in a specific instance any charge has to be made, the inquirer will be notified in advance before he is committed to any costs.

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